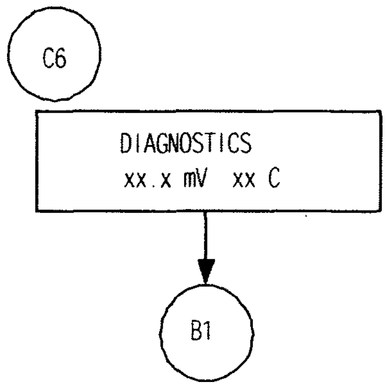
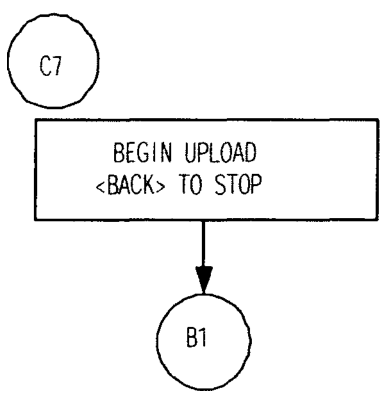
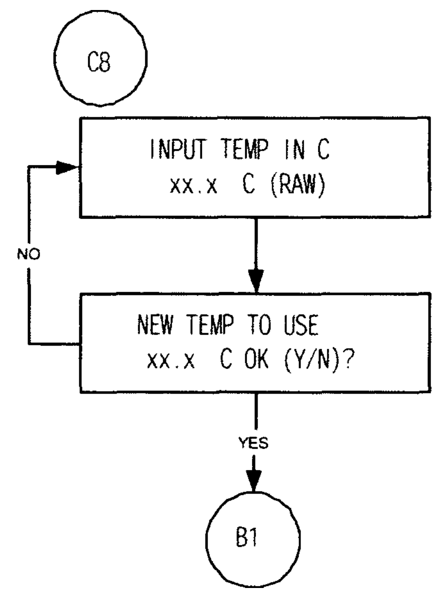
6) DIAGNOSTICS



7) PC UPLOAD



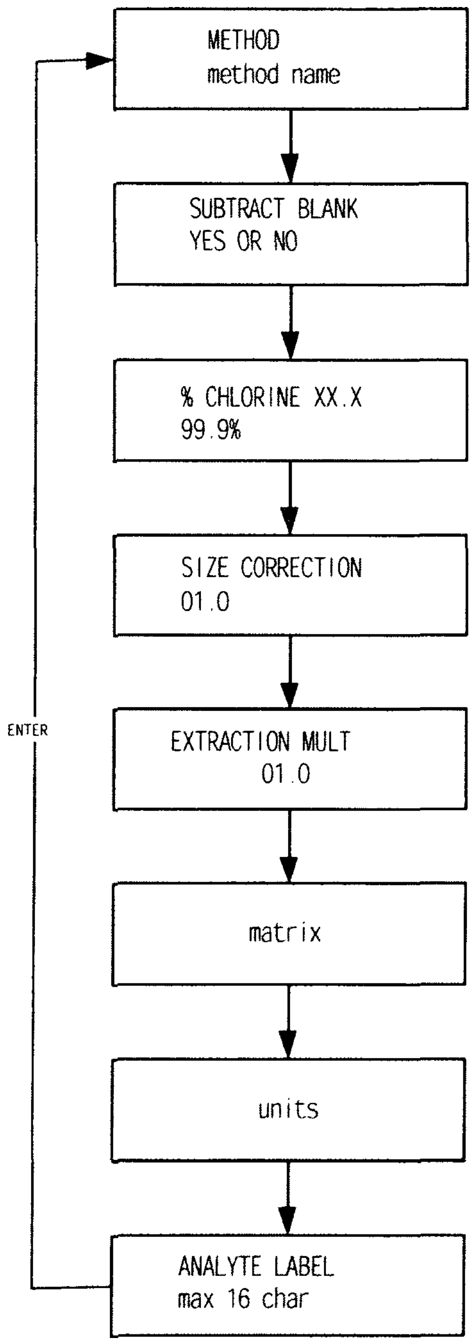
8) SET TEMP



REV 0, December 7, 2000

METHOD INFORMATION

B2



ENTER SCROLLS THROUGH METHOD. BACK RETURNS TO A2.

DEXSIL CORPORATION
L2000DX ANALYZER
ONE YEAR LIMITED WARRANTY

DEXSIL CORPORATION warrants the L2000DX Analyzer against defects in material or workmanship for a period of one year from the date of purchase. During the warranty period, any product which is determined by DEXSIL to be defective in material or workmanship and returned DEXSIL as specified below, will be, as the exclusive remedy, repaired or replaced at DEXSIL's option.

The cost of repair or replacement is included, shipping costs are not and are to be paid by the customer.

In the event that an L2000DX Analyzer is suspected to be defective contact a DEXSIL representative at the address below to obtain a return authorization:

DEXSIL CORPORATION
ONE HAMDEN PARK DRIVE
HAMDEN, CT 06517
TEL:(203) 288-3509
FAX:(203) 248-6523

Upon return of the unit it will be inspected and a determination will be made as to whether the pr is defective. If defective, arrangements will be made for repair or replacement without charge.

THE WARRANTY SET FORTH ABOVE IS EXCLUSIVE AND NO OTHER WARRANTY, WHETHER WRITTEN OR ORAL, IS EXPRESSED OR IMPLIED. DEXSIL SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

DEXSIL CORPORATION IS NOT LIABLE FOR INDIRECT OF CONSEQUENTIAL DAMAGES IN CONNECTION WITH THE USE OF THE PRODUCT.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so t above limitation or exclusion may not apply to you.

This Warranty applies only to parts or components which are defective and does not cover repairs necessary due to normal wear, misuse, or accidents.

All warranty repairs reimbursable under this warranty must be performed by DEXSIL CORPORATION or its representative using approved replacement parts.

Repairs or attempted repairs by anyone other than a DEXSIL representative are not reimbursable under this warranty. In addition, these unauthorized repair attempts may result in additional malfunctions, the correction of which is not covered by warranty.

This warranty gives you specific legal rights, and you may also have other rights which vary from to state.

SOP Number 12.0
Surveying (Conventional and GPS)

1.0 PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) provides technical guidance and procedures that will be employed to conduct conventional and Global Positioning System (GPS) surveying. It addresses equipment, field sampling procedures, field data collection, and personnel responsibilities.

Conventional and GPS survey techniques will be used to survey: surface soil and borehole locations and elevations; utility clearance (as applicable); and other surface and subsurface features.

The SOP is a general discussion of methods and surveying criteria. It is anticipated that the surveying will be performed by an experienced contractor that is knowledgeable of specific conventional and GPS surveying techniques. It is anticipated that the surveying method selection will be based on conditions encountered in the field and accuracy requirements.

2.0 RESPONSIBILITIES AND QUALIFICATIONS

The Field Manager has the overall responsibility for implementing this SOP. All personnel engaged in surveying will be knowledgeable and experienced in the surveying methods and equipment used. Surveying will be performed and/or directly overseen by a surveyor who is licensed and registered in the State of Colorado. Final surveys will be signed and certified by a licensed surveyor. The Field Manager will be responsible for assigning appropriate environmental staff to implement this SOP and for ensuring that the procedures are followed.

All personnel performing these procedures are required to have the appropriate health and safety training.

3.0 RELATED STANDARD OPERATING PROCEDURES

The procedures set forth in this SOP are intended for use with the following SOPs:

SOP No. 1.0	Staking, Utility Clearance, and Permitting
SOP No. 2.0	Subsurface Soil Sampling with a Hand Auger
SOP No. 3.0	Test Pit Excavation and Sampling
SOP No. 6.0	Near Surface Soil Sampling

4.0 REQUIRED ACCURACY

At a minimum, surveyed location coordinates will be determined to an accuracy of ±0.1 foot. At a minimum, surveyed elevations will be determined to an accuracy of ±0.01 foot for conventional surveying. Vertical elevation measured by GPS are suspect due to limited system accuracy. Accuracy will be assessed using the Federal Geographic Data Committee (FGDC) Geospatial Positioning Accuracy Standards. Environmental Protection Agency's (EPA's) Latitude/Longitude Standard (final May/June 2000) may be used to code accuracy for on-site point features.

5.0 CONVENTIONAL SURVEY

5.1 EQUIPMENT LIST

All materials and equipment necessary for conventional surveying will be provided by the land surveying contractor.

5.2 CONVENTIONAL SURVEYING PROCEDURES

This section specifies surveying performance requirements for conventional surveying techniques. The surveying methods will be specified based on project requirements.

5.2.1 Survey Points

Prior to surveying, all features and/or locations to be surveyed may be marked in the field with labeled stakes, survey flags, paint, or other marking devices. A meeting will be held prior to commencement of survey activities to discuss the surveying requirements and locations prior to initiating surveying. The following guidelines will be used when surveying:

- Abandoned boreholes will be surveyed at the center of the grout plug.
- Other surface features (e.g., surface sampling locations, geophysical and sampling grid points, surface water features, buildings or other man-made features) will be surveyed at the point marked.

5.2.2 Benchmarks and Coordinate Systems

Land surveying control will be established from known National Geodetic Survey (NGS) benchmarks, using Colorado State Plane, Central Zone. Horizontal datum will be North American Datum (NAD) 83, or subsequent adjustments (e.g., High Accuracy Reference Network or High Precision Geodetic Network). The vertical datum will be North American Vertical Datum (NAVD) of 1988.

6.0 GPS SURVEYING

6.1 EQUIPMENT LIST

The following survey equipment may be needed for conducting GPS surveying for this project:

- Dual-frequency real-time kinematic (RTK) GPS system (including GPS receiver, antenna, data logger)
- GPS base station or post-processing of data collected in the field

6.2 SURVEYING PROCEDURES

This section provides a general summary of GPS surveying procedures and specific procedures for surveying monitoring well and surface water/sediment sampling locations. However, these procedures should be supplemented by the specific survey instrument manufacturer's recommendations and generally accepted surveying practices.

- Land surveying control will be established from known National Geodetic Survey (NGS) benchmarks, using Colorado State Plane, Central Zone. Horizontal datum will be NAD83, or subsequent adjustments (e.g., High Accuracy Reference Network or High Precision Geodetic Network). The vertical datum will be NAVD of 1988.
- Surveying equipment will be field-verified each day before beginning surveying by establishing the coordinates of a known location (e.g., benchmark) using the GPS unit. The benchmark identification (or description) and measured coordinates will be recorded in the survey logbook.
- A base station will be established within an appropriate distance from the furthest survey point, as determined by the instrument manufacturer's specifications. Alternatively, the data will be post-processed by the surveyor. The base station may be used in connection with the field unit measurements to provide differential corrections to the field data.
- At each survey location, the location identifier and coordinates will be measured and stored in the data logger. As a backup, the same information will be recorded in the survey logbook.
- Data stored in the data logger will be downloaded at the end of each day of surveying and checked to determine if the data is reliable and to verify that coordinates have been collected for each survey location.
- Known benchmarks will be used to establish control points.
- If the coordinates at a survey location cannot be determined due to the presence of tree cover or other obstacles which prohibit adequate signal reception, coordinates will be obtained at a minimum of two alternate locations (offsets) close to the original survey location. The distance

and bearing from each of the alternate locations to the original survey location will then be determined using a measuring tape and compass.

The following procedure will be followed specifically for surveying monitoring well locations and top of casing elevations:

- Enter the monitoring well identification in the GPS data logger and also in the survey logbook for backup purposes.
- Measure the location in state plane coordinates (northing and easting) and elevation of the concrete pad adjacent to the monitoring well protective casing and store the coordinates and elevation in the data logger and record data in the survey logbook.
- Remove the monitoring well cap and measure the elevation of the top of the inner well casing (not the protective casing) on the north side of the well. Remove all visible debris from the tip of the survey rod before placing the rod on the top of the open well. Measure the top of casing elevation and store the elevation data in the data logger and in the survey logbook.

7.0 DOCUMENTATION

Documentation of observations and data acquired in the field will provide information on the acquisition of samples and also provide a permanent record of field activities. The observations and data will be recorded with waterproof ink in a permanently bound weatherproof field logbook with consecutively numbered pages, and on field data sheets as applicable.

The survey location identifier (i.e., sample location designation or monitoring well designation) and corresponding coordinates and elevation will be recorded in the data logger. As a backup, this information will also be recorded in the survey logbook. The documentation must be of sufficient adequacy to relocate survey points if station markers are lost or destroyed. Surveying activities and field observations will also be recorded in the survey logbook. Information that will be documented in the logbook include:

- Project name and number
- Surveying personnel
- Weather conditions
- Equipment used
- Daily field verification information (i.e., benchmark identification and coordinates)
- Survey location identification
- Survey location coordinates (northing and easting) and elevation
- Descriptions and coordinates of alternate survey locations (offsets)

- Measured distances from alternate survey locations to original survey locations
- GPS data and measurements documentation must include:
  - the make and type of the system used
  - the type of corrections made
  - the basis for the corrections
  - the accuracy calculated based on the corrections
  - a table which includes readings, location descriptor, northing and easting according to the State Plane or UTM coordinate system, any estimated elevation (if determined), and a map or sketch which indicates the GPS locations obtained
- A description of any conditions that may affect data integrity

SOP Number 12.0
Surveying (Conventional and GPS)

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SOP Number 13.0
Investigation Derived Waste Management

1.0 PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used for the handling, management, and disposal of investigation derived waste (IDW) encountered or generated during environmental activities. This SOP gives descriptions of equipment, field development procedures, field data collection, and personnel responsibilities.

2.0 RESPONSIBILITIES AND QUALIFICATIONS

Personnel performing these procedures are required to have the appropriate health and safety training. Personnel overseeing the handling and disposal of IDW will have IDW management knowledge and experience, or will work under the direct field supervision of knowledgeable and experienced personnel. Personnel will perform this work in accordance with the site health and safety plan (HASP).

Environmental staff and assay laboratory staff are responsible for reporting deviations from this SOP to the Field Manager.

3.0 RELATED STANDARD OPERATING PROCEDURES

The procedures set forth in this SOP are intended for use with the following SOPs:

SOP No. 2.0	Subsurface Soil Sampling with a Hand Auger
SOP No. 3.0	Test Pit Excavation and Sampling
SOP No. 6.0	Near Surface Soil Sampling
SOP No. 11.0	Polychlorinated Biphenyl Field Test Kit Analysis

4.0 EQUIPMENT LIST

The following materials and equipment may be needed for IDW management:

- Personal protective equipment (PPE) as outlined in the HASP
- Decontamination equipment and supplies (e.g., wash/rinse tubs, brushes, alconox, plastic sheeting, paper towels, sponges, baby wipes, garden-type water sprayers, large plastic bags (minimum 0.85 mil), potable water, distilled water and/or deionized water)
- Department of Transportation (DOT)-rated 55-gallon drums or other approved containers for containing soil cuttings, decontamination water, and formation water
- Drum/bung wrench and drum funnel
- Heavy equipment forklift or vehicle with drum grappler (as necessary)

- Laboratory-supplied sample containers
- Photoionization detector (PID) or flame ionization detector (FID)
- Wood pallets (as necessary)
- Non-porous (e.g., stainless steel) shovels
- Polyethylene tanks (as necessary)
- Field notebook and waterproof and permanent marking pens

5.0 PROCEDURES

It is anticipated that both non-liquid and liquid IDW will be generated or encountered during field activities. IDW generated during the removal actions is expected to include:

- Soil cuttings and other soil wastes generated during sampling
- Wash and rinse waste from decontamination activities
- Used PPE and other non-soil solid wastes

Sections 5.1 and 5.2 describe procedures for disposal of IDW. Section 5.4 addresses management and disposal requirements for off-site disposal and potentially hazardous materials.

5.1 SOIL IDW

- Soil cuttings generated during soil sampling will be placed into DOT-rated 55-gallon drums, or appropriately sized containers at the point of generation (e.g. roll-off).
- Mixing of the cuttings from several sampling locations is permissible in order to fill the drums.
- When drums or containers are full, or daily activities are completed, the drum lids and rings will be fastened. Full drums or containers will be transported to the designated IDW accumulation area on a regular basis to avoid accumulation of drums or containers at investigation sites for extended periods of time. Appropriate analyses will be evaluated prior to disposal.
- The waste soil drums or containers will be disposed offsite, as appropriate, based on analytical results.

5.2 LIQUID IDW

- Decontamination water will be contained in DOT-rated drums, or appropriately sized watertight containers, at the point of generation.
- When drums or tanks are full, or daily activities are completed, the containers will be sealed; for example, drum lids and rings will be fastened.

- Waste water IDW that is generated and containerized at project sites will be disposed offsite, as appropriate, based on analytical results.

5.3 PPE AND DISPOSABLE INVESTIGATION EQUIPMENT

- The plan for managing used PPE and other non-soil solid waste generated during field activities (e.g., sample handling) is to collect it in plastic trash bags and for the material to be disposed of as a solid waste.
- Potentially contaminated PPE or disposable investigation equipment will be decontaminated prior to placement in the plastic bags or containers, if warranted.
- Decontamination procedures consist of brushing off, or using small amounts of water to scrub off, gross potential contamination.

5.4 OFF-SITE DISPOSAL AND DISPOSAL OF HAZARDOUS MATERIALS

If it is necessary for IDW to be disposed of off-site, only TDCC-approved facilities will be used.

Disposal off-site of waste materials will be per TDCC's selected disposal facilities. Further information about waste disposal is included in Appendix D.

6.0 DOCUMENTATION

Documentation of field observations and data will provide information on the activities concluded and also provide a permanent record of field activities. The observations and data will be recorded with waterproof ink in a permanently bound weatherproof field notebook with consecutively numbered pages.

Project staff are responsible for thoroughly documenting IDW handling and disposal activities and are responsible for documenting the collection, transportation, labeling (if applicable), and staging or disposition of IDW. The information entered concerning IDW should include the following:

- Project Name
- Names of personnel
- Site location
- Type of activities
- Date waste generated
- Boring, well, or site number(s)
- Matrix

- Type of container(s)
- Estimated volume
- Disposition of contents
- Comments (field evidence of contamination [e.g., odors, staining])
- Any variance to procedures described in this SOP

REVISED DRAFT
REVISION 0.0
WORK PLAN APPENDIX C

QUALITY ASSURANCE PROJECT PLAN FOR MOLINE STREET PCB SITE INVESTIGATION AND REMOVAL ACTION

February 28, 2014

URS

URS Corporation
8181 E. Tufts Avenue
Denver, CO 80237

Project No. 41569671

Revised Draft

QUALITY ASSURANCE PROJECT PLAN
INVESTIGATION AND
REMOVAL ACTION WORK PLAN

Moline Street PCB Site

February 2014

Prepared by:
URS Corporation
8181 East Tufts Avenue
Denver, Colorado 80237

Approved:______________________________ ____________________
Karen Maestas — Date
URS Project Manager

Approved:______________________________ ____________________
Sheri Fling — Date
URS Project Quality Assurance Manager

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Revision Tracking

Revision No.	Date	Summary	URS Signature	EPA Signature
0.0	02/28/14	Revised Draft	Karen Maestas	Joyel Dhieux

Revision Tracking

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List of Acronyms

°C	Degrees Celsius
ADQ	Audit of Data Quality
CARs	Corrective Action Reports
CD	Compact Disc
CLP	Contract Laboratory Program
COC	Chain-of-Custody
DI	Deionized
DQA	Data Quality Assessment
DQOs	Data Quality Objectives
DPT	Direct Push Technology
DUP	Duplicate
EDD	Electronic Data Deliverable
EPA	Environmental Protection Agency
Ft	Foot/Feet
TA	TA Laboratories, Inc.,
HASP	Health and Safety Plan
HSM	Health and Safety Manager
IDW	Investigation Derived Waste
Kg	Kilogram
L	Liters
LCS	Laboratory Control Sample
LD	Laboratory Duplicate
LIMS	Laboratory Information Management System
MDL	Method Detection Limit
mg/kg	milligrams per kilogram
mL	Milliliter
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MSR	Management Systems Review
NA	Not Applicable
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NELAP	National Environmental Laboratory Accreditation Program
NIST	National Institute of Standards and Technology
NVLAP	National Voluntary Laboratory Accreditation Program
Oz	Ounce

List of Acronyms

PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PCBs	Polychlorinated Biphenyls
PDF	Portable Document Format
PE	Performance Evaluation
PM	Project Manager
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAM	Quality Assurance Manager
QAP	Quality Assurance Plan
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAO	Removal Action Objective
RL	Reporting Limit
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SOP	Standard Operating Procedure
SSL	Soil Screening Level
TDCC	The Dow Chemical Company
TSA	Technical Systems Audit
USEPA	United States Environmental Protection Agency

List of Acronyms

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Signature Page

To the best of my knowledge, after thorough investigation, I certify that the information contained in or accompanying this submission is true, accurate and complete.

____

Karen Maestas, URS Project Manager

Signature Page

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1.1 DISTRIBUTION LIST

QAPP Distribution	
Name	**Organization**
Tom Gieck	The Dow Chemical Company (TDCC) Representative
Joyel Dhieux	EPA On Scene Coordinator
Karen Maestas	URS Project Manager
Sheri Fling	URS Project Quality Assurance Manager

Data Distribution				
		Validated Data		**Preliminary Data**
Name	**Title**	**Hard Copy**	**Electronic**	**Hard Copy**
Tom Gieck	TDCC Representative	X	X	X
Joyel Dhieux	EPA On Scene Coordinator	X	X	X
Karen Maestas (or designee)	URS Project Manager	X	X	X

This document is the Quality Assurance Project Plan (QAPP) for the investigation and removal activities of The Dow Chemical Company (TDCC) former magnesium extrusion facility (Site) located at 3555 Moline Street in Aurora, Colorado. The purpose of the QAPP is to define procedures that confirm the quality and integrity of the collected samples and associated field data, the representativeness of the results, the precision and accuracy of the analyses, and the completeness of the data.

The investigation and removal action has two stages. Stage I, investigation and delineation and Stage II, Demolition and Excavation. The stages are described in detail in the Work Plan. This QAPP is Appendix C of the Work Plan for the investigation and removal action. The Standard Operating Procedures (SOPs) are Appendix B of the Work Plan.

1.2 PROJECT TASK ORGANIZATION

A Project Management Team for the investigation and removal action will oversee proper implementation of the standard operating procedures (SOPs), maintain communication, supervise data management and quality assurance/quality control (QA/QC) activities, supervise schedule and budget control, and check that the investigation is conducted in compliance with the Work Plan, SOPs, project-specific Health and Safety Plan (HASP), and all applicable local, federal, and state authorities. The following describes the primary Project Management Team.

1.2.1 Project Management Team

The investigation and removal action located at the Site will be performed by URS Corporation (URS), under contract to TDCC.

Following are the key personnel for this project:

- TDCC Representative – Mr. Tom Gieck
- EPA On-Scene Coordinator – Ms. Joyel Dhieux
- URS Project Manager – Ms. Karen Maestas
- URS Deputy Project Manager – Ms. Sarah Lave
- URS Project Quality Assurance Manager (QAM) – Ms. Sheri Fling
- URS Project Health and Safety Manager (HSM) – Mr. Tim Joseph
- URS Field Manager – Mr. Geoffrey Uhlemann
- URS Database Manager – Mr. Jeff Mott
- Project Staff
- Field and Analytical Laboratory Subcontractors

This organizational structure is designed to provide project control and proper QA/QC for the investigation. The roles and responsibilities of the key personnel are described below.

The Dow Chemical Company Representative

Tom Gieck, is the TDCC Representative team lead for technical oversight of URS's implementation of the investigation and removal action. The TDCC Representative will work with the Environmental Protection Agency On—Scene Coordinator (OSC) to keep the EPA informed of all scheduled activities and address concerns.

EPA On-Scene Coordinator

The EPA OSC, Joyel Dhieux, will be dedicated to providing on-site EPA representation for all field activities during implementation of the investigation and removal action. The EPA will be on-site whenever field activities are underway to see that all plans and SOPs are followed, and that public health, safety, and the environment are protected during the investigation.

URS Project Manager

The URS Project Manager, Karen Maestas, and Deputy Project Manager, Sarah Lave, are responsible for implementation of the investigation and removal action and coordination of the multidisciplinary team preparing the plans. The URS Project Manager will be responsible for staffing, directing, and planning the field effort, and compliance with budget and schedule. The URS Project Manager will coordinate and communicate with the TDCC Representative and EPA OSC. The URS Project Manager, together with the URS Project QAM is responsible for maintaining the official, approved QAPP, and for distribution of the QAPP, including updates..

URS Project Quality Assurance Manager

The URS Project QAM, Sheri Fling, is responsible for verifying that the soil investigation is performed in accordance with the Work Plan, QAPP, Standard Operating Procedures (SOPs), all applicable local, federal, and state authorities, and other applicable procedures. The URS Project QAM also has the responsibility to assess the effectiveness of the QA/QC program and to recommend modifications to the program when necessary and applicable. The URS Project QAM is responsible for confirming that personnel assigned to the project are trained on the requirements of the QA/QC Program. URS Project QAM will advise the URS Project Manager on implementation of the QA/QC program, but the QA/QC functions of the URS Project QAM and QA/QC coordinators are independent of the URS Project Manager. The URS Project QAM has the authority to halt work in case of major problems or nonconformances with the QAPP or if minor problems are not corrected in a timely manner.

URS Project Health and Safety Manager

The URS Project HSM, Tim Joseph , is responsible to verify that the work is performed in accordance with the HASP. He will work directly with the URS Project Manager. The URS HSM will advise the Project Manager regarding health and safety issues, but will function independently of the Project Manager.

URS Field Manager

The URS Field Manager, Geoffrey Uhlemann, is responsible for the conduct of all Site activities, including implementation of the Work Plan in the field. The URS Field Manager, or his designee, will be on-Site during all Site activities. The URS Field Manager will report to the URS Project Manager. The URS Field Manager, or designee, will be in charge of scheduling field activities and overseeing day-to-day field activities including all field measurements and data collection activities to check that they are conducted in accordance with the project Work Plan. The URS Field Manager or designee is responsible for the daily reports and checking that the field forms and log books are completed in accordance with the procedures in the Work Plan.

URS Database Manager

The URS Database Manager, Jeff Mott, is responsible for administering the environmental data management system. He is directly responsible for implementing the task-specific data management program, for checking the integrity of information uploaded into the environmental data management system, and for coordinating with the analytical laboratory(s) with respect to data management issues. The URS Database Manager will report to the URS Project Manager.

Project Staff

Members of the project staff are responsible for understanding and implementing their project tasks along with associated QA/QC procedures and in accordance with the Work Plan, HASP, and all applicable local, federal, and state laws and regulations.

Field and Laboratory Subcontractors

URS will subcontract to others, in writing, for the execution of some portions of project work, but will retain all contractual responsibilities to TDCC. When entities other than URS are retained by URS to perform project work, URS is solely responsible for such entities and for their activities; the entities and their activities will be monitored by URS to check for compliance with the Work Plan, the Scope of Work generated during the procurement process, the HASP, NCP, and all other applicable legal authorities.

TestAmerica Laboratories, Inc., of Arvada, CO has been subcontracted to conduct and manage the chemical analytical testing programs.

1.2.2 Data Management

Data management will be conducted in accordance with Attachment 1 of this QAPP which describes the database system to be used, the procedures for changes and backup, and the distribution of the database. Attachment 1 provides technical guidance and methods used to manage environmental data collected during the investigation.

1.3 PROBLEM DEFINITION/BACKGROUND

The problem definition/background is described in Work Plan Section 2.0

1.4 PROJECT TASK DESCRIPTIONS AND SCHEDULE

The project task descriptions and schedule are described in detail in Section 4.0 of the Work Plan.

TDCC intends to conduct additional investigation activities prior to commencing removal activities to better understand the excavation areas and depths for removal action planning purposes. The Work Plan discusses the delineation and removal of PCB-contaminated soil beneath and in the immediate vicinity of the Site as conducted in two separate stages, (I) investigation and delineation, and (II) demolition and excavation. The following activities will be performed during the stage I, investigation and delineation:

- Preparation (e.g., utility locates, procurement of subcontractors)-and mobilization for the field activities
- Asbestos sampling and inspection - Asbestos samples will be collected from the Site and the building will be inspected by a Colorado Certified Asbestos Building Inspector
- Wipe Sampling - Wipe samples will be collected from the building walls and ceiling prior to and after completion of the investigation and soil removal action. If PCB wipe samples indicate that PCB dust is present in the building, personal protective equipment (PPE) will be upgraded to Level C for the investigation activities
- Soil and Concrete Sampling – Soil and concrete samples will be collected for PCBs to estimate the lateral and vertical extent of contamination for excavation and demolition planning purposes, the number, depth, and location of borings will be subject to field observations by the URS field engineer or geologist
- Pre-Demolition Survey - A land surveyor licensed by the State of Colorado will establish a grid system at the Site that will be used to locate recently advanced borings, locate existing groundwater monitoring wells, define the excavation limits, and be used as a reference for locating excavation limits and grab samples

Demolition and excavation limits will be identified following the completion of Stage I activities. Stage II preparation activities will begin following the approval of planned demolition and excavation areas, which is anticipated to require a few weeks of evaluation and discussion. The following activities will be performed during the stage II, Demolition and Excavation:

- Mobilization and Work Area Preparation
- Demolition Activities – Removal of building structures and demolition and removal of concrete
- Demolition Debris Stock Piling and Off-site Disposal

- Excavation of Contaminated Soils
- Confirmation sampling - After soil excavation is completed, confirmation sampling of the excavation sidewalls and bottom will be performed to confirm removal of soil exceeding 100 mg/kg of PCBs and to evaluate and confirm achievement of the remedial action objectives (RAOs) which are listed in Section 1.5 below

The Work Plan present the details for performing stage I and stage II, and the analytical program is described in more detail in following sections of this QAPP.

1.5 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

1.5.1 Purpose/Background

The Data Quality Objective (DQO) process is a systematic planning tool based on the scientific method and is used to define the problem to be addressed, the decision to be made to address the problem, and for establishing data quality criteria and developing data collection designs necessary to make these decisions at the desired level of confidence. Establishing formal DQOs during the Work Plan development allowed for the generation of a clear and unambiguous definition of project objectives, decisions, and decision criteria so that data of sufficient type, quality, and quantity are generated to meet project objectives. The formal implementation of a DQO process brings structure to the planning process, thereby resulting in defensible decision making. Environmental Protection Agency (EPA) guidance document "*Guidance for the Quality Objective Process*" (USEPA, August 2000) details the DQO process and was used as guidance in developing the Work Plan.

The RAO for the Site is:

> *The goal of the removal action is to achieve a clean up level of 25 ppm at the surface and within the top twelve inches. Below the top twelve inches, the goal of the removal action is to achieve a clean up level of 100 ppm. All accessible contaminated soils and concrete at the Site will be replaced with clean soils and capped with concrete or asphalt.*

To meet these objectives, the DQO process was implemented in designing the removal action. Further discussion of the DQOs can be found in the investigation and removal action work plan.

1.5.2 Specify Quality Objectives

The primary goal of this QAPP is to define procedures that confirm the quality and integrity of the collected samples and associated field data, the representativeness of the results, the precision and accuracy of the analyses, and the completeness of the data.

The quality assurance objectives established for the wipe samples (Stage I prior to demolition activities to determine PPE requirements and Stage II after demolition to determine if the building needs to be cleaned for dust), soil samples (Stage I for delineation and Stage II for confirmation), and concrete samples (Stage 1 for delineation and stage II for removal) investigation are listed below.

1. Define the limits of acceptable inherent variability and uncertainty in the collected data. Defined limits will provide an acceptable level of uncertainty in the data for a given end use. These data quality measures will serve as decision criteria.
2. Implement SOPs for field sampling, sample custody, equipment operation and calibration, laboratory sample analysis, data reduction, and data reporting that are designed to demonstrate the correctness, consistency and thoroughness of data generation.
3. Assess the quality of data generated to confirm that all data are scientifically valid and of known and documented quality. This is largely accomplished by establishing measured criteria for sensitivity, precision, accuracy, completeness, representativeness, and comparability, and by testing generated data against acceptance criteria established for these parameters. A description of each measure is provided in Section 1.5.3. To meet the intended uses of the data, specific numeric acceptance limits are established for precision, accuracy, and completeness. The established precision and accuracy limits are specified in Section 2.4 (Analytical Method Requirements) and Attachment 2 (Analytical Data Validation). These limits are defined to verify routinely generated data are valid and defensible and are of known and acceptable precision and accuracy.
4. Achieve an acceptable level of confidence in the decisions that are made from data by controlling the degree of total error permitted in the data using QC checks. Data that fail the QC checks or do not fall within the acceptance criteria established will be evaluated for usability in meeting project objectives during data review.
5. Confirm that the QAPP and associated project-specific plans are properly implemented. In addition, verify that corrective actions are executed for any nonconformance identified through QA reports to management.

1.5.3 Specifying Measurement Performance Criteria

The overall QA objective for this project is to develop and implement procedures for obtaining and evaluating wipe soil sample data that meet the project objectives and to confirm that the required decisions can be made at the specified level of acceptable uncertainty. The QA procedures defined in this QAPP and the associated SOPs are established to demonstrate that field measurements, sampling methods, and laboratory analytical data provide information that is comparable and representative of actual field conditions, and that the data generated are technically defensible.

The analytical QA objectives are defined in terms of sensitivity and the parameters of precision, accuracy, representativeness, completeness, and comparability (PARCC). Data that meets the QA objectives and goals will be deemed acceptable. Data that do not meet objectives and goals will be reviewed on a case-by-case basis to ascertain their usefulness.

To meet the project objectives, the methods described in the Work Plan are designed to verify that a sufficient number of representative soil samples will be collected using technically valid procedures. For chemical analytical data, the QAPP requires implementation of procedures for obtaining and evaluating data in a manner that will result in a quantitative or qualitative representation of the PARCC parameters and sensitivity. The parameters of precision, accuracy, and completeness provide a quantitative measure of the quality of the data collected in this field program. The parameters of representativeness and comparability utilize documentation of the site and laboratory procedures to qualitatively evaluate the data. To evaluate the utility of the data for comparison to numeric standards or other project objectives (e.g., project identified RAOs)it is important that the sensitivity (detection limits) of the methods utilized is acceptable. Procedures for evaluating the PARCC and sensitivity parameters are provided in Section 3.1.2.2 (Assessment of Project Activities), Section 4.3 (Reconciliation with Data Quality Objectives) and Attachment 2 (Analytical Data Validation). The following sections describe the PARCC and sensitivity parameters in more detail.

1.5.3.1 Precision and Accuracy

The precision and accuracy of a data set are generally a function of sample collection technique, the analytical method, and sample matrix. Field duplicates will periodically be included in field batches and analyzed with sample delivery groups and the results used to evaluate precision and accuracy for soil samples. Precision and accuracy objectives for definitive analyses are documented in laboratory SOPs, which are based on standard EPA methods. The precision and accuracy achieved will be consistent with the requirements established by the laboratory method protocol, EPA method guidelines, and the requirements summarized in Section 2.4 (Analytical Methods Requirements).

The procedures for evaluating precision and accuracy data are provided in Section 3.1.2.2 (Assessment of Project Activities), Section 4.3, and Attachment 2. Samples will be re-collected and/or re-analyzed or data will be qualified, as necessary, on the basis of the results of these evaluations. If accuracy and precision goals are not attained, the reasons will be investigated, the potential impact on project decision-making evaluated, and corrective actions taken, if needed.

1.5.3.2 Representativeness

Representativeness is the parameter most concerned with verifying that data generated are representative of actual site conditions, via an appropriate sampling program design that includes: (1) implementation of appropriate and consistent procedures for sample collection; (2) application of acceptable methods; and (3) establishment of proper sampling locations. Representativeness of data is critical to data usability assessments. Each time a sample is collected, every effort will be made to collect a sample representative of the medium and depth interval being sampled. Representativeness expresses the degree to which sample data precisely and accurately represents a characteristic of a population, parameter variations at a sampling location, a process condition, or an environmental condition. Representativeness has both qualitative and quantitative aspects and is addressed throughout this document. It will also be quantitatively evaluated using precision and accuracy information developed from the evaluation of quality control (QC) samples, including field quality control blanks and duplicate composite samples.

1.5.3.3 Completeness

Following completion of the analytical testing and data validation, the overall percent analytical completeness will be calculated by the following equation:

$$\%\ \text{Analytical Completeness} = \frac{\text{Number of valid results or acceptable measurements}}{\text{Total number of requested measurements}} \times 100$$

The number of valid measurements includes data qualified as estimated. The total number of requested measurements includes all measurements determined at the end of the additional investigation. The project objective is 95 percent completeness.

1.5.3.4 Comparability

To evaluate the comparability of the data to other data collected during this same sampling event to be used in making project decisions, sampling and analytical techniques must be considered. Comparability of the data generated during the field investigation will be maintained by strictly following sampling SOPs, using standard analytical methods, evaluating data, evaluating the QC samples, reviewing laboratory reports, and reporting values in consistent units.

1.5.3.5 Sensitivity

To evaluate the utility of the data for comparison to numeric standards or other project objectives (e.g., project-identified RAOs) it is important that the sensitivity (detection limit) of the methods utilized is acceptable. For laboratory analysis, the QAPP specifies the use of routine and commercially available EPA approved methods. In general, these methods provide the necessary level of sensitivity. Prior to the start of testing, the ability of the laboratory to implement methods that attain the required sensitivity will be evaluated. During data validation, sensitivity that does not meet the proposed criterion will be identified to allow evaluation of whether these data adversely affect the ability to make decisions at the desired level of confidence.

Table 2-4 lists commonly used detection limits to meet project objectives.

1.6 SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

Personnel assigned to the project, including employees and consultants, will be qualified to perform the tasks to which they are assigned. Appraisal of personnel qualifications will be made by the URS Project Manager. The appraisal will include the comparison of the job assignment requirements with the relevant experience and training of the prospective assignee. It will also include a determination of whether further training is required, and, if required, by what method. On-the-job training is an acceptable training method if such training is provided by a person qualified to perform the trainee's assignment and the results of such training are documented and acceptable.

Additional training and certification requirements, including documentation of these requirements, can be found in the Site Health and Safety Plan.

1.7 DOCUMENTATION AND RECORDS

This Section discusses the documentation and records required for field sampling and laboratory analyses and reporting. Section 3 presents the report requirements for submittals to EPA. Data quality assessment reports are discussed in Section 3.1.2.2. Data validation report protocols and requirements are presented in Attachment 2.

1.7.1 Purpose/Background

The following paragraphs define critical project records and information that will be included in reports. Reporting formats and document control procedures that will be used on this project are also defined.

1.7.2 Field and Laboratory Reporting

The data reporting packages will include all data necessary to meet the project requirements. Field and laboratory records will be integrated, as much as possible, to provide a continuous reporting track.

1.7.2.1 Field Operation Records

At a minimum, the following field operation records will be included in the reporting packages.

1. Sample collection records (e.g. field forms, and electronic data files). These records will contain the names of persons conducting the sampling activity, sample number and location, number and type of samples collected, equipment, field processing/preparation of samples, required field observations, any unusual observations, and any references to bound field log books and the pertinent SOPs followed for sampling.
2. Completed Chain of Custody (COC) forms and Field Sample Receipt Logs. COC forms and Field Sample Receipt Logs will document custody changes and will also be used to assign analyses to be performed on field samples and field QC samples and the preservatives used.
3. A narrative in the field log book detailing the significance of any deviations from the methods prescribed in the QAPP, Work Plan, or SOPs, including photographs as necessary.

4. In the field log book, a description of mobilization and demobilization activities, including photographs as possible.
5. Log book for investigation derived waste (IDW) Records. These records will list IDW, sampling characterization, and disposal. Documentation of these activities will be attached.
6. Corrective Action Reports. These reports will include a narrative detailing any deviations from the methods prescribed in the Work Plan, significance, and resolution.
7. Field log books.

1.7.2.2 Laboratory Records

The laboratory data reporting packages will include at a minimum, the following laboratory records:

1. Sample data which will contain analysis date and time, sample number, method, method detection/quantitation limits, parameter name and result, dilution factors, data file numbers and laboratory identification numbers.
2. Sample management records which will contain documentation of sample receipt and storage.
3. A case narrative detailing the significance of any deviations from the methods prescribed in this QAPP and any QC nonconformances, problems or comments.
4. QA/QC Report which provides an overall summary of specific samples that are impacted as a result of any field or laboratory QA/QC problems. The report will also include instrument calibration and calibration verification data, blank data, spike data, surrogate recoveries, and any other relevant QC data.
5. Data handling records which will include copies of extraction bench sheets, instrument log book sheets, standard preparation logs, bench sheets, and calculation worksheets.
6. Raw data (e.g., instrument printouts, chromatograms, mass spectra).
7. Corrective Action Reports (CARs).
8. The laboratory will also prepare an electronic deliverable containing results and QC information. The electronic deliverable will be submitted as part of the data reporting package. The specifications for electronic deliverables are provided in Attachment 1 (Data Management Plan).

1.7.2.3 Data Reporting Package Format

Laboratory data reporting packages will include laboratory forms similar to contract laboratory program (CLP) forms, that summarize results and QC information and all raw data supporting the information on the summary forms (including bench sheets, if applicable).

The hardcopy data reporting packages will be paginated (including raw data) beginning with the case narrative. Handwritten information or corrections will be in indelible ink, dated and initialed. All handwritten corrections will be made by a single strike through line, the correction clearly written, dated and initialed. All corrections to the hardcopy package will also be carried through to the electronic files. Corrections may be made by the Analyst, Laboratory Supervisor, or Laboratory QA Manager.

The URS Project Manager or designee may initiate a revision of the laboratory data package. A revised laboratory data package, along with a narrative explaining the reasons for the revisions, would then be prepared by the laboratory and transmitted to the URS Project Manager or designee. Revised data will be clearly labeled as revised or additional data. Both revised and original data would be kept in the project data file, with clear indication of what original data are superseded by the revised data.

1.7.3 Field and Laboratory Document Archiving and Retrieval

Field documents (field forms and field log books) will be scanned and saved in portable document format (PDF). Similarly, data reporting packages (described above in Section 1.7.2.2) will be scanned and saved in PDF format. The laboratory will archive data reporting packages and instrument tapes and logs for a minimum of three years after data submission to URS. Data reporting packages, instrument tapes, and data logs will be provided to URS by the laboratory at the completion of project work, or within seven days following receipt of a written request from URS defining the information required.

URS will archive data packages and field documents with the project files until completion of the project. At that time, URS will provide the client with all originals from the project file, as well as an electronic copy. URS may retain a copy of the project file after Project Closeout.

1.7.4 Document Control

Copies of reports will be submitted to EPA as Draft and Draft Final versions for review and comment prior to submittal of a Final version of the report. Electronic copies will be kept in the URS project files. A revision tracking table will be included in the Work Plan, QAPP, and each of the SOPs. The initial version will be 0.0. Major revisions will increase the numbering by a whole digit, minor revisions by a decimal point.

Field log books, completed field forms, and field inventory forms will be assigned unique document control numbers maintained by the URS Field Manager or designee.

This section presents the sampling design and sampling requirements for collection of soil, wipe and concrete samples.

2.1 SAMPLING PROCESS DESIGN (EXPERIMENTAL DESIGN)

The sampling process design is described in the investigation and removal action work plan and includes the rationale for the number of samples to be collected of each media and the locations to be sampled.

2.2 SAMPLING METHODS REQUIREMENTS

The sampling method requirements are described in the Standard Operating Procedures (SOPs) found in Appendix B.

2.2.1 Purpose/Background

Recognizing that the quality of data collected for the investigation is critically dependent upon the quality of field sampling activities, detailed SOPs have been developed and will be implemented such that field operations for sample collection, processing, and shipping are well planned, carefully conducted, and subject to field audits throughout the project.

2.2.2 Sample Collection, Preparation, and Decontamination Procedures

Standard sample collection procedures and data collection forms have been developed for sampling and related data gathering activities. The purpose for these procedures is to obtain samples that represent the environment under investigation and to document sampling activities. Detailed description of the field sampling program, including SOPs, is presented in Appendix B. The procedures that will be used for sample collection and preparation for this investigation are included in the project SOPs (Appendix B).

2.2.3 Field Sampling/Measurement System Failure Response and Corrective Action Process

Sampling locations will be identified during investigation and subsequent removal activities. Any location accessibility problems will be identified at that time and an alternate location will be proposed meeting the data need intended by the original location. This decision would be made with concurrence from the Project Manager or their designee. If an alternate location is not available or accessible which still meets the original data need, the Project Manager or their designee will be consulted to determine the proper course of action. Any changes to the QAPP will be documented in the field logbook and recorded in the Daily Quality Control Report Form.

Any serious flaws noted during implementation of the Work Plan and/or during completion of a technical systems audit (Section 3.1.2) will be documented in the field logbook and recorded in the Daily Quality Control Report Form and brought to the attention of the Project Manager or their designee.

Any serious flaws noted prior to demobilization from the field which result in lost data will be rectified as achievable prior to demobilization. For example, any missed sample holding times may require the collection of additional samples prior to demobilization to satisfy the original data need.

2.2.4 Sampling Equipment, Preservation, and Holding Time Requirements

Sample preservation, container, volume, and maximum holding time requirements are described in Table 2-1 this QAPP. Certified clean sample containers for use in sample collection, with necessary preservatives added to the bottles, will be procured from the subcontracted analytical laboratories or vendor. A description of the various container types and manufacturers will be noted in the field log books maintained by the URS Field Manager.

2.3 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

2.3.1 Purpose/Background

Proper sample handling and custody, from the time of sample collection through the generation of data by analysis of that sample, will be directed by SOPs, monitored by URS staff, documented on designated forms, and audited to ensure that sample handling and custody problems do not occur and jeopardize data quality for this soil investigation.

2.3.2 Sample Management

Sample handling protocols are set forth in SOP 10.0, which details how the sample is field containerized, labeled, packaged, and shipped. Official custody of samples will be maintained, tracked, and documented from the time of sample collection, through preparation and analysis, and until sample disposal. Each sample will be identified, labeled, and logged on to a chain-of-custody (COC) form as a part of the procedure designed to demonstrate the integrity of the resulting data. The original COC form for each sample and its corresponding documentation will be maintained with the sample throughout the handling of the sample. The record of the physical sample (e.g., location and time of sampling) will be joined with the analytical results through accurate accounting of the sample custody. Sample custody procedures apply to both field and laboratory operations. Additional details are provided below.

Field Custody

Each sample must be in the custody of the sampler or sample manager from the moment it is extracted and containerized until sample shipment. Samples will be containerized, labeled, and sealed at the sample collection location. If sample manager is used, the samplers will relinquish containerized samples to a sample manager for completion of the documentation and preparation of the samples for shipment. Prior to shipment samples may be secured in a locked container overnight. Changes in custody (e.g., from sampler to sample manager, or a change in the daily sample manager) will be documented in the field book that identifies the personnel relinquishing custody and personnel receiving the custody of the samples. Field custody procedures are described in SOP 10.0, Sample Management.

Custody is initially established upon containerization. A sample is under custody if it is in:

- The possession of the field sampler/sample manager;
- The view of the sampler after being in the possession of the sampler/sample manager; or
- A secure location, after being placed there by the sampler/sample manager.

Laboratory Custody

The laboratory completing the chemical analyses will be required to maintain custody of the samples in a secure location with limited access from the time of sample receipt through sample disposal. Sample custody procedures within a laboratory will be documented in the laboratory quality assurance plan and/or SOPs. The laboratory is responsible for maintaining internal bound log books and records that provide custody records throughout sample preparation and analysis and disposal.

2.3.3 Sample Container Tampering

If, at any time after samples have been secured and shipped, custody seals on the cooler or sample containers are identified as having been tampered with, the following procedures will be conducted:

- The laboratory will notify the URS Project QAM or designee immediately.
- The URS Project QAM or Designee will notify the URS Project Manager.
- The URS Project QAM or designee will check with personnel having access to sample coolers to evaluate whether inadvertent tampering can be documented.
- The URS Project QAM or designee will document findings of the incident in a log book.

If it cannot be confirmed and documented that the custody seal was broken inadvertently and that the integrity of samples is unimpaired, the samples will be re-collected and the URS Project Manager and QAM will be notified.

2.3.4 Sample Archival and Disposal

Sample aliquots will not be archived as a part of this field investigation for future analysis or consideration. Any sample volume not consumed during sample analysis or archived will be disposed of by the laboratories as described in the laboratory quality assurance plan, and in accordance with applicable laws and regulations.

2.4 ANALYTICAL METHODS REQUIREMENTS

2.4.1 Purpose/Background

This section describes the analytical methods to be used to provide sample data necessary to meet the project objectives.

2.4.2 Subsampling

Soil samples will be collected as described in SOP 4.0, Direct Push Sampling. In addition wipe samples and concrete samples will be collected as described in SOP 5.0, and SOP 6.0, respectively. Analytical parameters, sample quantities, types and numbers of containers, number and types of QA/QC samples, sample preservatives, and sample holding times are listed in Table 2-1.

2.4.3 Preparation of Samples

Soil samples will be collected from the retrieved core based on lithologic contacts, visual staining, olfactory observations, and OVA readings. Samples will be collected as grab samples from the core recovered from direct push technology (DPT) drilling, as discussed in SOP No. 4.0. Grab sample material will be homogenized in a stainless steel bowl before filling sample containers. Soil samples collected during the investigation and removal action will be field screened using test kits, as described in SOP No. 11.0 (Appendix B), Polychlorinated Biphenyl Field Test Kit Analysis. The field kits manufactured by Dexsil Corporation (L200DX) have detection limits between 3 mg/kg and 2,000 mg/kg total PCBs The field kits will be used as a field screening tool, with at least 10% of the samples split and sent off for confirmation laboratory analysis. The confirmation laboratory analysis samples will be selected from those samples known to have field analysis results with total Aroclor PCBs ≥ 15 mg/kg in the surface and ≥ 50 mg/kg subsurface with at least one low-level or non-detect sample result submitted to evaluate the detection limit for the field method.

Wipe samples will be collected from the building walls and ceiling prior to and after completion of the investigation and soil removal action. In addition, when the building demolition and soil removal is completed, wipe samples will be collected from the walls and ceiling of the remaining building. If PCB dust is present, the building will be cleaned to remove the dust. Procedures for wipe sample collection are included in SOP 5.0 (Appendix B). Wipe samples will be analyzed at the field and fixed laboratory. The purpose of the wipe samples is to evaluate whether PCB dust is present or absent to help determine the level of PPE requirements for workers.

Concrete samples will be ground and tested for the presence of PCBs by TA. The concrete samples will be selected based on visual inspection (e.g., staining).

2.4.4 Analytical Methods

Tables 2-1 and 2-2 summarize the chemical analyses that will be completed during this investigation. For the analyses, soil sample results will be reported on a dry-weight basis.

Accuracy and precision requirements for each analyte of interest in each analysis are provided in Table 2-3 and in further detail in Attachment 2, Data Validation. Table 2-4 specifies the analytes to be analyzed,

The maximum allowable reporting limit requirements will not be exceeded when analyzing clean samples. However, sample dilutions may be necessary to bring high-level analyte concentrations into an acceptable instrument calibration range. The laboratory is required to report both the undiluted run and diluted run. Detection limits for non-detected analytes within those samples will be raised according to the level of the necessary dilution. Additionally, for a given method, intra-element interference and/or matrix effects may preclude the attainment of the desired detection limits. In these instances, the URS Project QAM or designee must be contacted immediately to determine the course of action to strive to meet required detection limits.

The analytical laboratories will be required to submit data packages as described in Section 1.7.2.2 in electronic format and case narratives associated with each analytical data package. The case narrative must document out-of-control events. In addition, any out-of-control occurrence must be reported to the URS Project QAM or designee as soon as possible so that the URS Project QAM and URS Project Manager can assess the out-of-control event and determine the appropriate course of action, based on the overall project objectives, critical nature of the data, and project schedule. At a minimum, the laboratory will report the types of out-of-control occurrences, how these occurrences are documented, and who is responsible for correction and documentation. Corrective action will be taken at any time during the analytical process, when deemed necessary based on analytical judgment or when QC data indicate a need for action. Laboratory corrective actions may include, but are not limited to (see Section 3.1.3):

- Reanalysis
- Calculation checks
- Instrument recalibration
- Preparation of new standards/blanks
- Re-extraction

- Additional training of analysts

The following items must be documented for out-of-control incidents so that corrective action may be taken to set the system back "in control." These items will constitute a corrective action report and will be signed by the laboratory director and the laboratory QA contact:

- Where the out-of-control incident occurred;
- When the incident occurred and was corrected;
- Who discovered the out-of-control incident;
- Who verified the incident;
- The scope of the problem;
- The corrective action implemented; and
- Who corrected the problem.

2.5 QUALITY CONTROL REQUIREMENTS

2.5.1 Purpose/Background

QC requirements relevant to analysis of environmental samples shall be followed during analytical activities to meet the quality objectives and criteria for measurement data described in Section 1.5. The purpose of this QC program is to produce data of known and documented quality that satisfy the project objectives and that meet or exceed the requirements of the standard methods of analysis. Table 2-3 presents the acceptance criterion for the laboratory QC samples (e.g., laboratory control sample [LCS], MS/MSDs, etc.) and field QC samples (e.g., field duplicate samples). Further discussion of QC samples (e.g. method blank) is presented in the section below.

2.5.2 QC Procedures

QC procedures used to monitor and verify sample data quality are presented throughout this QAPP and listed in this section.

- The sampling process design and sampling methods requirements are discussed in Section 2.1 and Section 2.2 respectively.
- Sample handling and custody requirements are discussed in Section 2.3.
- Analytical methods requirements are defined in Section 2.4, which includes the use of QC samples as a mechanism (data quality indicator) for ongoing control and evaluation of data quality measurements.

- Data quality indicators are presented in Section 1.5 and Section 4.3.
- Method-specific acceptance criteria for the data quality indicators are listed in Section 2.4 and supporting tables. QC procedures used to assess data quality include the assessment of QC samples and a reconciliation of data quality with end-use objectives.

2.5.2.1 QC Samples

A number of QC samples and measures will be employed to assess various data quality parameters, such as representativeness of the environmental samples, the precision of sample collection and handling procedures, the thoroughness of the field equipment decontamination procedures, and the accuracy and bias of laboratory analysis.

Laboratory QC samples (e.g., blanks and laboratory control samples) shall be included in each preparation batch for analysis with the field samples as applicable for each given method. An "analytical batch" is a number of samples (not to exceed 20 environmental samples, not including analytical/ preparatory batch QC samples, equipment blanks, and field blanks) that are similar in composition (matrix) and that are extracted or digested at the same time and with the same lot of reagents. These samples may then be prepared in more than one preparation batch. The term "analytical batch" also extends to cover samples that do not need separate extraction or digestion (e.g., volatile analyses by purge and trap). This analytical batch is a number of samples (not to exceed 20 environmental samples) that are similar in composition (matrix) and analyzed sequentially. The identity of each analytical batch shall be unambiguously reported with the analyses, so that a reviewer can identify the QC samples and the associated environmental samples.

Additional QC checks for the analytical methods are specified in the methods and will be followed. The additional checks may include initial calibration, continuing calibration checks, and calibration blanks, . The acceptance criteria for each of these checks are specified in the method. Corrective actions will be considered acceptable if subsequent QC checks indicate the laboratory analytical method is in control.

The laboratory must follow the calibration criteria QC acceptance criteria specified in the analytical method and those presented in Section 2.4.

Types of QC samples are discussed below and the frequency of these samples is presented in Table 2-1.

2.5.2.1.1 Laboratory Control Sample

The laboratory control sample (LCS) is analyte-free (non-detect at the specified reporting limit) water or solid spiked with all analytes for the method listed in the QC acceptance criteria (Table 2-3) in Section 2.4. The spike concentrations will be documented in the appropriate laboratory SOPs or QAPP. All spiking solutions must be traceable to the National Institute of Standards and Technology (NIST), EPA, or American Association of Laboratory Accreditation (A2LA) or equivalent.

The LCS shall be carried through the digestion/ extraction and analysis procedure. The LCS is used to evaluate each analytical batch and to determine if the method is in control. The LCS cannot be used as the continuing calibration verification. An LCS shall be included at the frequency specified in each method. The performance of the LCS analysis is evaluated against the QC acceptance limits given in the tables in Section 2.4.

Whenever an analyte in an LCS is outside the acceptance limit, method-specified corrective action shall be performed. After the system problems have been resolved and system control has been reestablished, all samples in the analytical batch shall be reanalyzed for the out-of-control analyte(s).

2.5.2.1.2 Matrix Spike/Matrix Spike Duplicate

Matrix spike (MS) and matrix spike duplicate (MSD) samples are prepared by spiking additional aliquots of samples with known concentrations of all project target analytes for the methods listed in the QC acceptance criteria table in Section 2.4 for the method. Additional sample mass will be submitted for preparation of MS and MSD samples. The MS analysis will not be performed on a blank sample. The MS is used to evaluate the accuracy and bias of the analyses with respect to the site-specific matrix, and the MSD is used to evaluate the precision of the sampling and analysis. The spiking occurs prior to sample preparation. The spike concentrations will be documented in the appropriate laboratory SOPs or QAPP. All spiking solutions must be traceable to the NIST, EPA, A2LA, or equivalent.

The MS/MSD shall be designated on the COC form. The MS/MSD is used to document the bias of a method due to sample matrix. Consequently, MSs and MSDs are not used to control the analytical process. A minimum of one MS and one MSD sample shall be analyzed for every 20 environmental aliquots tested, with at least one MS and MSD submitted per sampling area, as applicable to the analytical method. MS/MSD samples are not required for the equipment blanks. The performance of the MS and MSD analysis is evaluated against the QC acceptance limits given in the tables in Section 2.4.

2.5.2.1.3 Surrogates

Surrogates (sometimes referred to as system monitoring compounds) are organic compounds that are similar to the target analyte(s) in chemical composition and behavior in the analytical process, but that are not normally found in environmental samples. Surrogates are used to evaluate accuracy, method performance, and extraction efficiency. Surrogates shall be added to all environmental samples, controls, and blanks, in accordance with the method requirements during sample preparation or extraction, but prior to analyses.

Whenever a surrogate recovery is outside the acceptance limit, method-specified corrective action must be performed.

2.5.2.1.4 Method Blank

A method blank is an analyte-free (non-detect at the specified RL) matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank shall be carried through the complete sample preparation and analytical procedure and is used to document contamination resulting from the analytical process. A method blank shall be included in every preparation batch.

The presence of analytes in a method blank at concentrations equal to or greater than the method-specified thresholds indicates a need for corrective action. Corrective action shall be performed to eliminate the source of contamination prior to proceeding with analysis. After the source of contamination has been eliminated, all samples in the analytical batch shall be prepared again and reanalyzed. No analytical data shall be corrected for the presence of analytes in blanks.

2.5.2.1.5 Equipment Blank

An equipment blank is a sample of laboratory-provided deionized (DI) water poured into or over or pumped through the sampling device, collected in a sample container, and transported to the laboratory for analysis. Equipment blanks are used to assess the effectiveness of equipment decontamination procedures used to prevent cross-contamination between sampling locations. The frequency of collection for equipment blanks shall be a minimum of 1 equipment blank for every 20 environmental soil samples collected and analyzed with a given type of sampling equipment, and only for sampling equipment which is decontaminated and reused to collect environmental samples. Equipment blanks will be handled in a manner identical to samples and shall be analyzed for all laboratory analyses requested for the environmental samples collected at the site using the subject equipment (see Table 2-2).

2.5.2.1.6 Field Duplicates

Co-located field duplicate soil samples will be collected to assess precision of field sample collection for bulk samples and grab samples only. A field duplicate sample is a second separate sample volume collected at the same location as the original sample; homogenization is not performed between the original sample and the field duplicate. Soil field duplicate samples are collected in succession from the same sample source and device.

The soil sample field duplicate is collected using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. The frequency of collection for field duplicates is a minimum of 1 duplicate sample from each group of 20 environmental samples. Field duplicate samples are not required for equipment blanks. Specific locations for collection of field duplicate samples may be designated prior to the beginning of sample collection. A field duplicate is not required for wipe samples or concrete samples.

2.5.2.2 Reconciliation of Data with Quality Objectives

Section 4.3 describes the process by which data quality indicators (presented in Section 1.5) are reconciled against the method-specific acceptance criteria listed in Section 2.4.

2.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

2.6.1 Purpose/Background

The following section discusses procedures used to verify that all instruments and equipment are maintained in sound operating condition and are operating at acceptable performance levels.

2.6.2 Testing, Inspection, and Maintenance

Testing, inspection and preventative maintenance activities will be carried out on both field and laboratory equipment through regularly scheduled maintenance checks.

2.6.2.1 Field Equipment

Field equipment that will be used during this investigation is listed in the SOPs as found in Appendix B. Equipment will receive routine maintenance checks to minimize equipment breakdowns in the field. The maintenance of the equipment will be performed in accordance with manufacturer operation manuals and documented in maintenance logbooks. Daily inspections for visible signs of wear or breakage will be performed. If a piece of equipment is unusable due to operational check failure or breakage, itwill be repaired (if possible), removed from service, or replaced. Frequency of calibration for field equipment is described in Section 2.7, and calibration procedures are discussed in Section 2.7. Decontamination of all equipment will be completed as described in SOP 8.0.

2.6.2.2 Laboratory Equipment

As part of its QA/QC program, the laboratory will conduct a routine preventative maintenance program to minimize the occurrence of instrument failure and other system malfunctions. Guidelines for inspection and preventive maintenance of equipment will be established in the laboratory quality assurance plan/SOP(s). Essentially, inspection and preventive maintenance will be implemented on a scheduled basis to minimize downtime and to provide accurate measurements from laboratory equipment. This program is designed to achieve results commensurate with the specified capabilities of equipment operation, thus generating data of known quality without concern for misapplication. In addition, back-up equipment and critical spare parts will be maintained to quickly correct equipment malfunction, and emergency repair or scheduled manufacturer maintenance may be provided under a repair and maintenance contract with factory representatives.

All equipment and instruments used to generate data will be adjusted and maintained to operate within manufacturers' specifications and the method requirements. Maintaining the necessary accuracy, precision, sensitivity, and traceability of the equipment helps to provide reliable measurements and representative data. Methods and intervals of inspection and maintenance will be based on the type of equipment; stability characteristics; required accuracy; intended use; and environmental factors (such as temperature, humidity, etc.). Such an effort will be conducted by trained technicians using service manuals or through service agreements with a qualified maintenance contractor. In addition, procedures will promote the proper use of equipment by trained personnel.

Inspection, maintenance, schedules, and records will be maintained for the equipment, as appropriate. Both equipment and equipment records will be located in a controlled access facility. Equipment that is identified as malfunctioning will be removed from operation until repaired. After repair and before use, the instrument shall be re-inspected and the laboratory must demonstrate that the instrument is back in working order. This may be accomplished by meeting the prescribed method and QAPP QC protocol such as sensitivity checks, calibrations, and QC standards using reference materials such as the NIST's Standard Reference Materials. Adequate documentation must be maintained by the laboratory, as identified in the laboratory quality assurance plan, to demonstrate that instruments and equipment are operating within method-required criteria.

2.7 INSTRUMENT CALIBRATION AND FREQUENCY

2.7.1 Purpose/Background

Calibration procedures used for instrumental analytical methods used in environmental measurements are described in this section.

2.7.2 Identification of Instrumentation Requiring Calibration

Instrumentation requiring calibration is divided into field equipment and laboratory equipment, each described below.

2.7.2.1 Field Equipment

As previously stated in Section 2.6, field equipment that will be used during this investigation is listed in the SOPs as found in Appendix B. Field equipment will be calibrated according to the manufacturers' recommendations as described in the equipment manual. Equipment that fails calibration, a daily operations check, or becomes inoperable during use will be removed from service and segregated to prevent inadvertent use. Such equipment will be repaired and satisfactorily recalibrated prior to reuse. Equipment that cannot be repaired will be replaced.

Those field instruments requiring calibration and the frequency and make-up of that calibration are listed in the SOP 11.0 (Appendix B) Field instruments requiring calibration will be calibrated using traceable standards, as available.

2.7.2.2 Laboratory Equipment

The laboratory quality assurance plan and SOPs will provide calibration details to be reviewed during the management systems review (MSR) or the Technical Systems Audit (TSA) to demonstrate compliance with SW846 calibration protocols, the information below, and requirements in Sections 2.7.3 and 2.7.4.

Instruments required to perform the analytical methods listed in the Section 2.4 tables are defined within SW846 methods. All instruments will be calibrated in accordance with the method requirements with regard to frequency. Instruments that fail calibration will be removed from service. Such instrumentation will be repaired and satisfactorily recalibrated prior to reuse. All analytes to be reported will be present in the initial and continuing calibrations, and calibrations will meet the acceptance criteria specified in the method, at a minimum. Results reported will be within the calibrated range.

The initial calibration will be checked at the frequency specified in the method using standard materials. Multi-point calibrations will contain at least the minimum number of calibration points specified in the method, with all points used for the calibration being contiguous.

If more than the minimum number of standards is analyzed for the initial calibration (i.e., SW-846 methods), all of the standards analyzed will be included in the initial calibration unless linearity acceptance criteria are not met. In such a case, the highest or lowest standard may be omitted to meet linearity acceptance criteria. If the low point standard is omitted, the reporting limit for associated data must be adjusted accordingly. If linearity criteria cannot be met by dropping either the high or low point standard when more than the minimum number of standards is analyzed for the initial calibration, the instrument must be recalibrated.

2.7.3 Documentation of Instrument Calibrations

Instrument calibrations will be documented to include at a minimum: identification of the instrument calibrated, the date and time of calibration, the analytes and concentrations of those analytes included in the calibration mix, and traceability of the calibration standard to a reference solution. Records of instrument calibration will be maintained and submitted with the final data package.

2.7.4 Documentation of Calibration Standards

Records of standards used to calibrate field instruments will be retained in the project file. Records of standards preparation and/or dilutions completed by laboratories will be maintained and submitted with the final data package as appropriate for each method. Calibrations will be completed using certified equipment and/or standards with known and demonstrated valid relationships to nationally-recognized performance standards. Standards must comply with method-specified holding time requirements. The preparation and use of all working standards must be recorded in bound laboratory notebooks that document standard traceability to EPA, A2LA, NIST or equivalent criteria. Standards not obtainable under these programs must be approved prior to use.

2.8 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

2.8.1 Purpose

The purpose of this section is to establish and document a system for inspecting and accepting all supplies and consumables that may directly or indirectly affect the quality of the project.

2.8.2 Identification of Supplies and Consumables

Supplies and consumables consist of field and laboratory supplies and consumables, each described below.

2.8.2.1 Field Supplies and Consumables

The consumables that will be used during field operations include decontamination fluids and water for equipment and field blank preparation. No material will be used beyond the manufacturers' suggested expiration date. The decontamination fluids will be visually inspected for gross contamination and considered usable if no visible contamination is present. If contamination is visible, the item will be discarded and replaced. The water used for the preparation of the equipment blanks will be laboratory provided DI water. DI lot numbers will be recorded as part of preparing field and equipment blanks. If detections are reported in the equipment blanks, an effort will be made to determine the source of the contamination. If the contamination source is not discernible, decontamination procedures may be changed or the use of dedicated equipment instituted. The samples associated with a contaminated blank will be reviewed to determine if the potential contamination has affected the usability of the data. The data will be reviewed and determinations of use made on a case-by-case basis (Section 4.1).

2.8.2.2 Laboratory Supplies and Consumables

The laboratory will inspect supplies and consumables prior to their use in analysis. The materials description in the analytical methods will be used as a guideline for establishing acceptance criteria for those materials. Purity of reagents will be monitored through the analysis of blanks and an LCS. An inventory and storage system for all supplies and consumables will be established. The inventory system will be documented in the laboratory quality assurance plan. No material will be used beyond the manufacturers' suggested expiration date.

2.8.3 Inspection Requirements and Procedures

Maintenance of inventory, inspections and acceptance of the field supplies and consumables is the responsibility of the URS Field Manager. Maintenance of inventory, inspections and acceptance of the laboratory supplies and consumables will be completed as specified in the laboratory quality assurance plan.

2.8.4 Tracking and Quality Verification of Supplies and Consumables

Supplies and consumables requiring a degree of purity and received from vendors specifying the degree of purity will have the vendor specifications retained in the project file for field consumables and retained by the laboratory for laboratory consumables.

It is the responsibility of the URS Field Manager to verify that field supplies and consumables that do not meet specification, have expired, or do not meet acceptance criteria are not used for the project.

2.9 DATA ACQUISITION REQUIREMENTS (HISTORICAL DATA)

Historical data are presented in the Work Plan. There are no data requirements linked to previous soil investigations.

2.10 DATA MANAGEMENT

2.10.1 Purpose/Background

Data reduction, verification, and reporting procedures and project data management activities, data/information exchange, and reporting procedures must demonstrate that complete documentation is maintained, transcription and reporting errors are minimized, and all data received from field investigations and laboratories are properly reviewed.

2.10.2 Data Recording

Internal checks used to verify data quality during data entry are discussed in Section 2.10.5. Internal checks used to verify the quality of data resulting from calculations is discussed in Section 2.10.4.

2.10.3 Data Validation

The assurance that data are of sufficient quality to meet project objectives is achieved through the validation and verification of analytical data, as discussed in Attachment 2. Data supported by attainment of all laboratory performance criteria and measurement quality objectives will be usable for this project. Data not supported by such attainment may be used, if the data quality assessment (described in Attachment 2) demonstrates that limits on project decision errors are not compromised.

2.10.4 Data Transformation

The conversion of data points using formulae, data transformations and calculations will be checked to verify the correctness of the result or the software calculating the result. Laboratory data transformation will be completed in accordance with the laboratory quality assurance plan and related SOPs. Computer/software data transformation is discussed in Sections 2.10.6 and 2.10.7.

Major URS hand calculations will be recorded on calculation sheets and will be legible and in logical progression with sufficient descriptions. Major calculations will be checked by an engineer or scientist of a professional level equal to or higher than that of the originator. After ensuring that any mistakes have been corrected, the checker will sign and date the calculation sheet immediately below the originator. Both the originator and checker are responsible for the correctness of calculations. The following information will be recorded for each major calculation or a series of calculations, as applicable:

- Project title and brief description of the task;
- Task number, date performed, and signature of person who performed the calculation;
- Basis for calculation;
- Assumptions made or inherent in the calculation;
- Complete reference for each source of input data;
- Methods used for calculations, including reference;
- Results of calculations, clearly annotated;
- Problem statement;

- Input data clearly identified; and
- Variables listed.

2.10.5 Data Transmittal

All data that are manually entered from log books or field forms into a computer file will be verified after data entry for correctness. Similarly, all data that are transcribed from one log book or field form to another will be verified after data transcription for correctness by the URS QAM or designee. Data received electronically will be reviewed for obvious signs of corruption and information loss prior to use. Analytical data are usually received electronically from subcontracting laboratories. Specific data fields and file formats must be established and tested prior to data delivery to verify that the formats are compatible with the project database and all required information is reported in compliance with project requirements. Analytical data received electronically from a laboratory should be compared (at a minimum frequency of 10%) with the laboratory hard copy reports to verify correct data transfer. If systematic discrepancies or random errors are found, the frequency must be increased to verify that the data received are at least 99 percent error free. The level of review completed should be documented and corrective actions must be identified and implemented if systematic or high random error rates occur. Further detail regarding data management activities is provided in Attachment 1, Data Management Plan.

2.10.6 Data Reduction

This section outlines the methodology for the data reduction process.

2.10.6.1 Non-Laboratory Data Reduction

The following procedures describe steps for verifying the accuracy of data reduction. Data will be reduced either manually on calculation sheets or by computer. The following responsibilities will be delegated in the data reduction process:

- Technical personnel will document and review their own work and are accountable for its correctness.
- Major calculations will receive both a method and an arithmetic check by an independent checker. The checker will be accountable for the correctness of the checking process.
- A Peer Review scheduled by the URS Project Manager or designee, will be conducted to demonstrate the consistency and defensibility of the concepts, methods, assumptions, calculations, etc. for major calculations.

- The URS Project Manager or designee will be responsible for confirming that data reduction is performed in a manner that produces quality data through review and approval of calculations.

As data are reduced, care must be taken so that critical data (e.g., significant figures) are not lost.

Commonly used software will be referenced by a complete citation in reports and data packages. Documentation of in-house software and programs, including a complete description of the methodology implemented, analyses and functions being performed, verification documentation, and quality control checks will be included in the project file. A complete citation of the documentation will be included with reports and data packages.

2.10.6.2 Laboratory Data Reduction

The specific data reduction, verification, and reporting procedures and assigned personnel vary between laboratories; however, equivalent procedures must be performed by each laboratory to verify that accurate and consistent data handling, review, and reporting are achieved. Laboratory-specific procedures are evaluated during technical systems audits to demonstrate that the process steps described here are properly performed.

The laboratory analyst performing analyses is responsible for the reduction of raw data generated at the laboratory bench to calculate sample concentrations. The data reduction procedures are described in the laboratory's method SOPs. For many methods, data reduction software is included with the instrument or Laboratory Information Management System (LIMS). In those cases, the analyst must verify that the data reduction was correct. The system may require manual manipulation to correctly calculate sample concentrations.

The analytical process includes verification or a QA review of the data. Specific requirements, acceptance criteria, and corrective actions for each analysis are included in the analytical method. The QC checks are reviewed at several levels by laboratory analysts, supervisors, designated QC specialists, document control staff, or by a combination of these staff. After the data have been reviewed and verified, the laboratory reports are signed and released for distribution.

Most laboratories use a LIMS to electronically track and report sample and QC data. The data are reported electronically from the LIMS to the project staff using pre-established formats. The LIMS files must also undergo a QC check to verify that the results are complete and correct, and that the files are properly formatted.

2.10.7 Data Analysis

Computer analyses include the use of models and programs. Both systematic and random error analyses will be investigated and appropriate corrective action measures taken. The URS Project

Manager or designee will evaluate, determine applicability, and document the use of automated data reduction techniques if needed on this project.

For in-house programs developed specifically for this project, the URS Project Manager or designee will review documentation prior to use. This documentation will be prepared in accordance with computer program verification procedures and will contain at a minimum:

- Description of methodology, engineering basis, and major mathematical operations,
- Flow chart presenting the organization of the program, if appropriate, and
- Test case(s), sufficiently comprehensive to test all program operations.

QC procedures for checking models (or programs) will involve reviewing the documentation, running the test case, and manually checking selected mathematical operations. Each computer run used to check a model or program will have a unique number, date, and time associated with it appearing on the printout.

Documentation of in-house software and programs, including a complete description of the methodology implemented, analyses and functions being performed, verification documentation, and quality control checks will be included in the project file. A complete citation of the documentation will be included with reports and data packages.

2.10.8 Data Tracking

Laboratory and field data must flow properly to the project staff and data users. Procedures must be established to verify that data are properly reported and undergo QC review before use.

A data management plan should exist for each laboratory to be used and should be addressed in the laboratory quality assurance plan or SOPs. All electronic and hard copy data received from laboratories will be tracked for completeness of delivery, scanned and saved in PDF format, and ultimately filed in the project data file. Care must be taken to verify that all final laboratory data are received and documented.

Field measurements, lithologic data, and sample collection information will be recorded and filed in the field log book for use and reference before ultimately being filed into the project data file, and scanned to PDF format.

2.10.9 Data Storage and Retrieval

Data generated during the field investigation and follow-on removal action will be maintained in the project files located in the URS office in Denver, Colorado. As soon as possible after generation, original hardcopy data will be scanned to a PDF format and saved in the electronic file. The original hardcopy will then be placed in the project data files. If the information or data are needed for interpretation of results or report completion, copies will be used. The cover page of the copies will be labeled as such to avoid multiple copies of the same document in the files. All field-generated data, such as field forms and log books, will be reviewed for completeness and legibility prior to incorporation in the data files. If corrections are needed, the document will be returned to the originator for correction. Laboratory data will be copied immediately upon receipt (or a second copy delivered by the laboratory), scanned to a PDF format, and the original placed in the data files. Information obtained from outside sources will be maintained in the project files only if the information is not publicly available. For instance, documents used as guidance (e.g., EPA QA/R-5) will not be maintained in the project files. Historical information specific to the Site may also be maintained in the project files. At the time of Work Assignment closeout, project files will be turned over to the TDCC Representative, in PDF format. A write-protected electronic copy of the populated final relational database, laboratory analytical data packages (in hard copy and electronic copy), and copies of the laboratory Electronic Data Deliverable (EDD) will be provided to the TDCC Representative.

Electronic data and electronically generated reports and data interpretations will be stored on the Denver URS office network. The network is backed up daily and weekly to avoid data loss. Retrieval of documents may be limited to personnel who have been granted access to the appropriate network drive. Sensitive or final electronic documents may become password protected to prevent inadvertent changes. Electronic laboratory data will be copied to the Denver URS office network prior to incorporation into any databases to maintain an original copy. Electronic project correspondence will be maintained in the project files. It is the URS Project Manager's responsibility to verify that project personnel comply with this requirement. At project or work assignment closure, all project correspondence will be copied onto disks or CD-ROM and will be delivered to the TDCC Representative; one copy may be archived by URS.

Table 2-1
CHEMICAL ANALYSES FOR FIELD AND QC SAMPLES

Analytical Parameter	Analytical Method (a)	Sample Matrix	Estimated Number of Lab QC Samples (b)		Estimated Number of Field QC Samples		Preserv-ation	Number of Container(s)/ Minimum Volume (c)	Sample Hold Time (from collection)
			MS	MSD or DUP	Field Duplicate	Equipment Blank			
Polychlorinated Biphenyls (PCBs)	SW846 8082A	Soil	1 per 20 samples		1 per 20 samples	1 per 20 samples	Cool to ≤6 °C	4 oz Jar	14 days to extraction; 40 days after extraction
PCBs	SW846 8082A	Wipe	NA		NA	NA	Cool to ≤6 °C	1 Wipe	14 days to extraction; 40 days after extraction
PCBs	SW846 8082A	Concrete	NA		NA	NA	NA	Slab	14 days to extraction; 40 days after extraction

Table 2-1
CHEMICAL ANALYSES FOR FIELD AND QC SAMPLES

Analytical Parameter	Analytical Method (a)	Sample Matrix	Estimated Number of Lab QC Samples (b)		Estimated Number of Field QC Samples		Preserv-ation	Number of Container(s)/ Minimum Volume (c)	Sample Hold Time (from collection)
			MS	MSD or DUP	Field Duplicate	Equipment Blank			
PCBs (Equipment Blank)	SW846 8082A	Water	NA		NA	NA	Cool to ≤6 °C	2 1-liter ambers	7 days to extraction; 40 days after extraction

Footnotes:

(a) Or equivalent method approved by the URS Project QAM or designee.
(b) As applicable to the Method.
(c) Or other equivalent bottles provided by the laboratory.

Definitions:

SW846: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Final Update IV, January 2003.
°C Degrees Celsius
DUP Matrix Duplicate
MS Matrix Spike
MSD Matrix Spike Duplicate
NA Not Applicable
oz Ounce
PCBs Polychlorinated Biphenyls
QC Quality Control

Table 2-2
CHEMICAL ANALYSES FOR EQUIPMENT BLANKS

Analytical Parameter	Analytical Method (a)	Sample Matrix	Preservation	Number of Container(s)/ Minimum Volume (b)	Sample Hold Time (from collection)
Polychlorinated Biphenyls	SW846 8082A	Water	Cool to ≤6 °C	1 L Amber	7 days to extraction; 40 days after extraction

Footnotes:

(a) Or equivalent method approved by the URS QAM or designee.
(b) Or other equivalent bottles provided by the laboratory.

Definitions:

SW846: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Final Update IV, January 2003.
°C Degrees Celsius
L Liters

Table 2-3
QUALITY ASSURANCE OBJECTIVES FOR INVESTIGATIVE SAMPLES

Analysis	Accuracy	Precision

Organics
PCBs
	Generate historical lab recovery limits for LCS, MS, and surrogates using method 8000 procedures
	- Calculate average % recovery (P) for 15-20 samples and standard deviation (σ) for each compound
	Upper limits = P + 3σ
	Lower limits = P – 3σ
		Generate historical lab precision limits for MS/MSD and LD using Method 8000 procedures
		OR
		If there are no historical lab precision limits:
		If both results are >5xRL, then
		RPD ≤35%
		If either sample result is ≤5xRL, then
		Absolute difference ≤ ±2x greater RL
		FD
		If both results are >5xRL, then
		RPD ≤50%
		If either sample result is ≤5xRL, then
		Absolute difference ≤ ±3.5x greater RL

Notes:
FD = Field duplicate
LCS = Laboratory control sample
LD = Laboratory duplicate
MS/MSD = Matrix spike/matrix spike duplicate
PCBs = Polychlorinated biphenyls
RL = Reporting limit
RPD = Relative percent difference

Table 2-4
PCBs DETECTION LEVELS

Analyte	Reporting Limit[1] (µg/kg)	MDL/ (µg/kg)	Reporting Limit[1] (µg/wipe)	MDL/ (µg/wipe)
	Soil/Concrete Samples		Wipe Samples	
Aroclor 1016	17	2.3	0.25	NA
Aroclor 1221	17	1.2	0.25	NA
Aroclor 1232	17	2.1	0.25	NA
Aroclor 1242	17	1.4	0.25	NA
Aroclor 1248	17	0.70	0.25	NA
Aroclor 1254	17	3.3	0.25	NA
Aroclor 1260	17	2.2	0.25	NA
Aroclor 1262	17	1.2	0.25	NA
Aroclor 1268	17	0.8	0.25	NA

Notes:
[1] Reported reporting limits and MDLs will be dependent upon dilutions, percent moisture, and preparation factors.
MDL = Method Detection Limit
PCBs = Polychlorinated biphenyls
µg -= micrograms
kg = kilogram
NA = Not Applicable

3.1 ASSESSMENTS AND RESPONSE ACTIONS

3.1.1 Purpose/Background

A process of evaluation and validation is necessary to demonstrate that data collection is conducted according to this QAPP. The URS Project QAM, whose responsibilities are described in Section 1.2, will have the primary responsibility for implementing the internal and external assessments necessary to verify:

- All elements of this QAPP are correctly implemented as prescribed;
- The quality of the data generated through implementation of this QAPP is adequate to provide expected confidence in project decisions; and
- Corrective actions are implemented in a timely manner, properly documented, and their effectiveness confirmed.

These internal and external assessments are described in the following sections. If at any time in the assessment process it is discovered that this QAPP is not being correctly implemented, the quality of the data being generated is not adequate to meet project objectives, or corrective actions are not completed as necessary, the URS Project QAM will immediately notify the URS Project Manager. While it is the responsibility of the URS Project Manager to resolve problems and/or issue stop work orders as necessary, the URS Project QAM also has the authority to halt work in case of major problems or non-conformances with the QAPP.

3.1.2 Assessment Activities

Assessment activities to be implemented to demonstrate data collection is conducted according to this QAPP follow.

3.1.2.1 Assessment of Subsidiary Organizations – Analytical Laboratory

Assessment of TestAmerica Laboratories Inc., (TA) may be comprised of a management systems review (MSR), sample receipt review, and technical systems audit (TSA).

Management Systems Review (MSR). URS may complete an MSR for TA for chemical analysis prior to sample collection. The MSR will be an assessment of the TA's quality management structure, policies, practices, and procedures to establish that TA is capable of obtaining the type and quality of data required for this project. At a minimum, the MSR will include the following.

- A qualitative review of the TA's quality assurance plan. Internal QA procedures, key personnel and responsibilities, organizational charts, corrective action procedures, reporting procedures, documentation procedures, lists of SOPs, lists of instrumentation, instrumentation maintenance schedules, and data review, verification, and reporting procedures should all be clearly presented and described. TA's quality assurance plan should be a controlled document, dated, signed by TA's QA Manager, and updated or reviewed at least every two years.

- Confirmation that TA has documented SOPs for sample receipt and storage, data review, verification, and reporting and all methods to be performed by the subcontracted laboratory. Method SOPs should contain appropriate method citations, all deviations from the cited EPA methods, control windows, corrective actions, and quantitation limits. SOPs should be dated, signed by the TA's QA Manager, and updated or reviewed at least every two years.
- A qualitative review of performance evaluation studies from the past year. As applicable, the TA QA Manager should provide at least the most recent two sets of results for each method to be performed from their participation in the National Voluntary Laboratory Accreditation Program (NVLAP), EPA laboratory proficiency program, EPA interlaboratory studies or National Environmental Laboratory Accreditation Program (NELAP).
- A quantitative comparison of the TA's quantitation reporting limits and method detection limits against project-required detection or reporting limits for all target analytes to be determined. Method detection limits should be at least half the project-required detection or reporting limits whenever possible.
- URS will notify TDCC of all major subcontractors.

Sample Receipt Review. TA's project manager will review all sample login information and will fax or email URS COC forms and sample login information by close of business each day that samples are received. TA's project manager will immediately notify URS if there is any problem with sample receipt (i.e. broken samples, elevated temperature blanks, etc.).

Laboratory Technical Systems Audit (TSA). A TSA is a thorough and systematic onsite qualitative audit where laboratory facilities, method implementation, data reduction and reporting procedures, equipment, personnel, training, procedures, and record keeping are examined for conformance to this QAPP. Any deviations revealed during a TSA will be communicated to the URS Project Manager or designee and to TA in an audit findings report. The laboratory must respond to the audit findings report and provide detailed corrective actions. The URS Project QAM may issue a stop work order if any finding seriously affects the data quality objectives. URS may conduct a TSA of the subcontracted laboratory at any time during working hours for the duration of the project. A TSA may be conducted on TA prior to or during the first sampling event by the URS Project QAM.

3.1.2.2 Assessment of Project Activities

Surveillance. The URS Project QAM or designee will review daily project records, such as field log books and field forms and question project personnel to verify that Work Plan, SOPs, and QAPP-specified requirements are being met. If surveillance reveals these requirements are not being met, the Project QAM or designee will suggest corrective actions to the URS Project

Manager. The URS Project QAM or designee will continue surveillance to verify the corrective action is implemented.

Field TSA. A TSA is a thorough and systematic on-site qualitative audit where field procedures, equipment, personnel, training, and record keeping are examined for conformance to this QAPP (and supporting SOPs). The field TSA may be conducted during the sampling event as scheduled by the URS Project QAM, although URS may conduct a TSA of the field procedures at any time for the duration of the project. The URS Project Manager will notify the EPA OSC when the TSA is scheduled.

Any deviations revealed during a TSA that could negatively impact data quality will be communicated immediately to the URS Field Manager, who will resolve the problem, and document the problem and its resolution. A subsequent audit findings report will consist of audit observations and audit findings. Audit observations include discovery of items not negatively impacting data quality and recommendations for improvements in current procedures. Audit findings that negatively impact data quality require immediate resolution by the URS Field Manager. URS's Program Manager or designee must respond to the audit findings report and provide detailed corrective actions (Section 3.1.3). The URS Project Manager may issue a stop work order if any finding seriously affects the data quality objectives. The EPA OSC will be provided with a copy of the audit findings report and documentation of corrective actions taken.

Audit of Data Quality (ADQ). URS may conduct an ADQ to evaluate how project personnel handled data, made judgments, and whether uncorrected mistakes were made. Peer reviews will be conducted on this project instead of ADQs.

Data Quality Assessment (DQA). A DQA section will be prepared for the final report that documents the overall quality of data collected in terms of project DQOs, measurement quality objectives, laboratory performance criteria, and the effectiveness of the data collection and generation processes. The data assessment parameters calculated from the results of the field measurements and laboratory analyses will be reviewed to demonstrate that all data used in subsequent evaluations are scientifically valid, of known and documented quality, and, where appropriate, legally defensible. In addition, the performance of the overall measurement system will be evaluated in terms of the completeness and effectiveness of field measurement and data collection procedures. Finally, the goal of the DQA is to present the findings in terms of data usability.

The degree of total error in the results derived from data collection must be determined, so that the level of confidence in decisions based on the results can be known. The methods and procedures used to determine total error follow:

- Assess the quality of measured data to verify that each value is scientifically valid, of known and documented quality, and, where appropriate, legally defensible. This will be accomplished by calculating actual data values for project DQOs using acquired data (defined in Section Four), and by evaluating each value against its measurement performance criteria and laboratory performance standards presented in Section Two.

- Data that pass pre-established QC checks will be considered useable. Data that fail pre-established QC checks will be evaluated for usability against project DQOs. These data may be determined valid without qualification, may be qualified for limited use, or may be qualified as unusable (rejected) for any use.

The major components of the DQA are presented below and show the logical progression of the assessment leading to determination of data usability:

- **Data Validation Summary.** Summarizes the individual data validation reports for all sample delivery groups by analytical method. Systematic problems, data generation trends, general condition of the data, and reasons for data qualification are presented.
- **Data Evaluation Procedures.** Describes the procedures used to further qualify data caused by such factors as dilution, reanalysis, matrix effect, and imprecision between duplicate analyses of samples. Examples of the decision logic are provided to illustrate the methods by which qualifiers are applied.
- **QC Sample Evaluation.** Evaluates applicable QC samples such as equipment blanks, field duplicates, performance evaluation (PE) samples and laboratory control samples to assess the quality of the field activities and laboratory procedures.
- **Assessment of Data Quality Objectives.** Assesses the quality of data measured and generated in terms of accuracy, precision, representativeness, and completeness through the examination of laboratory and field control samples in relation to DQOs (Section 4.3). Evaluate the quantitation limits and method detection limits, as adjusted for dilution and dry weight.
- **Summary of Data Usability.** Summarizes the usability of data, based on the assessment of data conducted during the previous four steps. Sample results for each analytical method will be qualified as acceptable, rejected, estimated, biased high, or biased low.

3.1.2.3 Schedule of Assessment Activities and Personnel

A proposed sampling schedule is presented in the Work Plan. The schedule for the field and laboratory MSR and TSA is to be determined.

3.1.3 Nonconformance and Corrective Actions

Provisions for establishing and maintaining QA reporting to the appropriate management authority will be instituted such that early and effective corrective action can be taken when data quality falls outside project DQOs, measurement quality criteria and laboratory performance standards (acceptance criteria). In this context, corrective action involves the following steps:

- Discovery of a nonconformance,
- Identification of the responsible party to allow formulation of an appropriate corrective action,

- Planning and scheduling of corrective action,
- Review of the corrective action taken, and
- Confirmation that the desired results were produced.

Activities subject to QC and QA will be evaluated for compliance with project DQOs, measurement quality criteria and laboratory performance standards. These activities include both field and laboratory operations as described in this QAPP. A lack of compliance with these procedures will constitute a nonconformance. The URS Project QAM is responsible for reviewing all assessment, audit and nonconformance reports to determine areas of poor quality or failure to adhere to established procedures.

The URS Project QAM, or any other project member who discovers or suspects a nonconformance (including those involving subcontractors), will report nonconformances promptly and directly to the URS Project Manager and initiate a nonconformance report. The URS Project Manager, in consultation with the URS Project QAM, will promptly evaluate all reported nonconformances and see to it that no additional work that is or may be adversely affected by the nonconforming activity is performed until the confirmed nonconformances are corrected. The URS Project Manager will notify the EPA OSC of nonconformances and provide a copy of nonconformance reports.

Resolution of nonconformance will be made by the URS Program Manager, with concurrence of the URS Project QAM; and corrective actions must also be approved by the EPA OSC Corrective actions will be selected to prevent or reduce the likelihood of future nonconformance and to address the causes of the nonconformance. Corrective actions should be appropriate to the seriousness of the nonconformance and realistic in terms of the resources required for implementation.

Upon completion of the corrective action, the URS Project QAM will evaluate the effectiveness of the corrective action. If the corrective action is found to be adequate, the URS Project QAM will notify the URS Project Manager of the satisfactory closure of the corrective action. If the corrective action is found inadequate, the URS Project QAM and URS Project Manager will confer with the EPA OSC to resolve the problem and determine any further corrective actions. Implementation of any further action will be scheduled by the URS Project Manager. The URS Program Manager or URS Project Manager may issue a stop work order in cases in which significant problems continue or corrective actions were not completed. The EPA OSC will be notified prior to any stop work order.

The URS Project Manager is responsible for assuring that field data generated are of the quality specified in this QAPP, and for documenting any nonconformances and associated corrective actions. The URS Project Manager is also responsible for executing the corrective action and confirming that the nonconformance has been resolved. In the case of subcontracted laboratories, performance will be measured through the data review and validation process. The TA QA Manager will be responsible for assuring data generated are of the quality specified in this QAPP and included in the Scope of Work, and for documenting any nonconformances and associated corrective actions required during the analysis of project samples.

3.2 REPORTS TO MANAGEMENT

Audit finding reports, nonconformance reports, CARs and stop work orders will be transmitted, as they occur, to the EPA OSC and URS Project Manager. MSRs will be transmitted as they occur to the URS Program Manager.

4.1 DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

This section describes the process for determining that project data were collected in a way that meets at least the specified QC acceptance criteria (verification – evaluation of the QC samples) and determining that project results are suitable for use in making the specified decision (validation – assessment of the PARCC parameters and method detections limits with respect to the screening criteria) as detailed in Section 3.1.2.2 (Assessment of Project Activities). The data validation process is detailed in Attachment 2, Analytical Data Validation.

4.1.1 Introduction

The analytical data review process for chemical analyses to be conducted under this QAPP will consist of two levels of review. The first level of review is performed by TA. The TA review program is designed to verify that analytical data of known and acceptable quality have been provided by the laboratory. The second level of review is to be conducted by a person(s) independent of the laboratory. The review of data packages received from the laboratory is designed to evaluate whether the data generated are of sufficient quality for their intended use. The independent data validation process will be used to make an overall assessment of the data set and the usability of each analytical result.

TA will review and verify 100% of all data generated at the laboratory, and field personnel will review and verify 100% of all data generated in the field.

URS laboratory data review, validation, and verification will be performed by qualified chemists (either by degree or experience) who were not involved in data generation.

The data validation and verification procedures contained in Attachment 2 Analytical Data Validation will be followed and documented in the validation report.

The following paragraphs specify criteria to be used in data review, verification, and validation.

4.1.2 Laboratory Data Reduction, Verification, and Reporting

Data reduction, verification, and reporting procedures will be completed in accordance with TA's Quality Assurance Plan and SOPs. The laboratory analyst is responsible for the reduction of raw data generated at the laboratory bench. The analyst must verify that data reduction performed by an instrument or Laboratory Information Management System is correct.

The laboratory personnel will verify all generated data as follows:

- Verify calibrations and calibration checks for compliance with laboratory criteria and criteria presented in Section 2.4.
- Verify that batch QC samples were analyzed at the frequency specified in Section 2.4.
- Verify that QC sample results were within the specifications in Section 2.4.

- Compare raw data (chromatograms, etc.) with the reported concentrations for accuracy and consistency.
- Verify that holding times for extractions and analyses were met.
- Verify that quantitation limits and method detection limits are current and correct.
- Determine whether corrective actions were performed and control was adequately reestablished and documented, prior to reanalysis of QC or project samples.
- Verify that all project and QC sample results were properly reported and flagged.
- Prepare batch narratives that adequately identify and discuss any problems encountered.
- Verify that the data reported on the electronic data deliverable, as defined in Attachment 1 Data Management Plan, match the hardcopy report.

These QC checks will be reviewed by laboratory analysts, supervisors, QC specialists and the assigned laboratory project manager, or by a combination of these staff. After the data have been reviewed and verified, the laboratory reports are signed and released for distribution. This constitutes the first level of data validation.

4.1.3 Field Data Reduction, Verification, and Reporting

The purpose of the validation process is to evaluate the usability of the field data that are collected or documented in accordance with specified protocols outlined in the Work Plan, QAPP and related SOPs.

First, field data will be verified at the time of collection by following the QC checks outlined in the QAPP and SOPs. Field personnel should personally review their records at the end of each day for completeness and correctness.

Second, data recorded on sample collection sheets will be verified by the URS Project QAM or designee (i.e., contractor QAM). Field documentation will be reviewed to identify discrepancies or unclear entries. Field data will be verified against the following criteria, as appropriate:

- Sample locations
- Field instrumentation utilized and calibration
- Sample collection protocol in accordance with pertinent SOPs
- Sample volume collected is adequate for intended analyses
- Sample preservation (including periodic field checks)
- Field QC blanks (e.g., equipment blanks) collected and submitted at the proper frequency
- Field duplicate samples submitted at the proper frequency

- Additional sample volume for MS/MSD and MS/D analyses submitted at the proper frequency per matrix
- Sample documentation protocols were followed
- COC protocols were followed
- Sample shipment

4.1.4 Data Validation

In accordance with Attachment 2, all analytical chemistry data will be reviewed independently of the analytical laboratory. This review will consist of evaluation of laboratory performance parameters and sample-specific parameters.

The laboratory performance parameters are indicators of overall performance and the ability of the laboratory to generate data of known quality. The laboratory performance parameters that will be evaluated as appropriate to the method include:

- Initial Calibration
- Initial and continuing calibration verification
- Laboratory control sample results
- Standard Reference Material (SRM) sample results
- Compound identification
- Result calculation
- Data transcription
- Method specific quality control requirements (e.g., thermal stability, tuning, resolution, mass calibration, interference check sample analysis).

Sample-specific parameters are those that are sample related. The sample matrix or the collection procedures could influence the results. The sample-specific parameters that will be evaluated as appropriate to the method include:

- Case narrative comments
- Chain-of custody and sample conditions upon receipt
- Holding times
- Method blank results
- Surrogate recoveries
- Matrix spike recoveries
- Laboratory duplicate or spike duplicate results

- Results for field quality control samples (e.g., field duplicates and equipment blanks).
- Any systematic problems noted in the review of the laboratory performance parameters.

All data will receive an evaluation of sample-specific parameters. In addition to sample-specific review, full validation will be conducted. Data intended for stringent uses (e.g., litigation support, etc.) will receive a review of laboratory performance parameters for at least one data package or 10% of the data (per method), whichever is greater.

As discussed in Attachment 2, results will be qualified to alert the user to potential limitations on the use of the data.

4.1.4.1 Flagging Conventions

All data will be validated and qualified using guidance from the following: U.S. EPA Contract Laboratory Program *National Functional Guidelines for Organic Review* (USEPA, 2008). Data will be flagged as necessary per the flags in Table 1 and Table 2 of Attachment 2.

4.2 VALIDATION AND VERIFICATION METHODS

Data verification and validation will be completed at the frequency specified in Section 4.1 using the guidance documents specified in Section 4.1. The URS Project QAM is responsible for receiving data from the analytical laboratories, assigning qualified data reviewers/validators, and reviewing completed data review/validation checklists or review narratives. Data reviewers/validators are responsible for completing data review/validation checklists or review narratives, assigning data qualifiers, tabulating results, and communicating nonconformances to the URS Project QAM. The data reviewer/validator will notify the URS Project QAM of any nonconformance revealed in the data review or validation. The URS Project QAM will report nonconformances promptly and directly to the URS Project Manager and initiate a nonconformance report. The URS Project Manager, in consultation with the URS Project QAM, will promptly evaluate all reported nonconformances and see to it that no additional work that is or may be adversely affected by the nonconforming activity is performed until the confirmed nonconformances are corrected.

4.3 RECONCILIATION WITH DATA QUALITY OBJECTIVES

Once the data verification and validation procedures have been completed, the URS Project QAM or designee will be responsible for preparing a DQA report as described in Section 3.1.2.2, and transmitting the DQA report to the URS Project Manager. The following tools may be used in evaluating the results against the soil investigation DQOs detailed in the Work Plan. Additional discussion of these tools is included in Section 1.7.

4.3.1 Precision

Field Duplicate, Laboratory Duplicate, MS/MSD

Precision involves examining the spread of data about their mean. The spread represents how different the individual reported values are from the average reported values. Precision is thus a measure of the magnitude of errors and will be expressed as the Relative Percent Difference (RPD) or the relative standard deviation (RSD) for all methods. The lower these values are, the more precise are the data. These quantities are defined as follows:

$$\textbf{RPD (\%)} = \frac{100 * |S-D|}{\left(\frac{S+D}{2}\right)}$$

$$\textbf{RSD (\%)} = (s/X) \times 100$$

where:

D = Concentration or value of an analyte in a duplicate sample

S = Concentration or value of an analyte in an original sample

X = Mean of replicate analyses

s = Standard deviation

4.3.2 Accuracy

Accuracy measures the average or systematic error of an analytical method. This measure is defined as the difference between the measured value and the actual value. Accuracy will be expressed as the percent recovery. This quantity is defined as follows:

$$\textbf{Recovery (\%)} = \frac{|SC-UC|}{KC} \times 100$$

where:

SC = Measured spiked concentration of an analyte

UC = Measured unspiked concentration of an analyte (assumed to be zero for LCS and surrogates)

KC = Known concentration of an analyte

4.3.3 Completeness

Completeness establishes whether a sufficient amount of valid measurements were obtained. The closer this value is to 100, the more complete the measurement process. The overall project analytical completeness goal is 95%. Completeness will be calculated as follows:

$$\textbf{Completeness (\%)} = \frac{V}{R} \times 100$$

where: V = Number of valid measurements (includes data qualified as estimated)

R = Number of requested measurements

4.3.4 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent the environmental condition. Representativeness is achieved in part through using standard sampling and analytical procedures described in this QAPP and SOPs. Representativeness is also influenced by appropriate program design and such elements as sampling locations and procedures.

Field duplicates will be used to evaluate how representative a sample collected is of a sample location. Laboratory or method duplicates will be used to evaluate how representative an aliquot taken from a sample is of a given sample. Following a determination of precision, a statement on representativeness will be prepared, noting the degree to which the data represents the environment. Additionally, as noted in the data validation SOP, the results obtained for field quality control blanks will be used to assess representativeness quantitatively (i.e., results less than five times amounts found in associated field quality control blanks will be qualified as non-detect).

4.3.5 Comparability

Comparability expresses the confidence with which one set of data can be compared to another. Comparability is important during this investigation, and will be significant for future evaluations of Site data. Comparability is influenced strongly by the analytical extraction methods and analytical methods used to quantify concentrations of contaminants. It is also influenced by variance in the application of these methods and procedures. All process variables that are afforded latitude within the extraction and analytical methods being used will be documented and the conditions implemented during this project will be carefully documented so that analyses performed at a later date will have the same result. Following the determination of both precision and accuracy, a statement on comparability will be prepared in relation to use of the data sets in further evaluations of the environmental and contaminant conditions under investigation. A statement on comparability will also be prepared when the data collected are used with data reported from another study. All important test variables will be discussed, including solvent ratios, equipment models and configuration, extraction temperature and temperature control, time of extraction, etc.

SECTIONFIVE **References**

USEPA. 2008. *USEPA Contract Laboratory Program National Functional Guidelines for Organic Review.*

USEPA. 2000. *Guidance for the Quality Objective Process.*

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Attachment 1
Data Management Plan

ATTACHMENT 1
DATA MANAGEMENT PLAN

QAPP
Investigation and Removal Action
Moline Street PCB Site

Attachment 1 Data Management Plan

List of Tables

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1.0 INTRODUCTION

This Standard Operating Procedure (SOP) provides technical guidance and methods used to manage environmental data collected during the course of the investigation and removal action for Smith Road and Moline Street. This plan serves to supplement task specific work plans and field sampling plans and is intended to be used in conjunction with these documents.

2.0 PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES

Data management will be performed by personnel knowledgeable and experienced in environmental data management for similar projects, or personnel who will work under the direct supervision of knowledgeable and experienced personnel. The Data Manager will have a bachelor's degree in information management or equivalent experience and will be familiar with the operation and requirements of the environmental database management system.

The Data Manager is responsible for administering the environmental data management system and for coordinating with and granting access to the appropriate personnel. The Project Manager, Project Chemist, Field Manager, Data Manager, and analytical laboratory personnel are responsible for implementing this plan on a task-specific basis as summarized below.

- The Project Manager has overall responsibility for the data management program for each task and for providing the Data Manager with construction and location information for new sampling sites.
- The Project Chemist has the responsibility for updating the database with the appropriate information based on validation and for providing hard copies of laboratory reports to the data manager for quality assurance purposes.
- The Field Manager is responsible for ensuring that field sampling teams follow the sample numbering scheme described in SOP 10.0, Sample Management and for providing the data manager with legible copies of all field records for data entry and quality assurance purposes.
- The Data Manager has direct responsibility for implementing the task-specific data management program, for ensuring the integrity of information uploaded into the environmental data management system, and for coordination with the analytical laboratory(s) with respect to data management issues.
- Laboratory personnel are responsible for providing the Data Manager with the appropriate electronic data in the prescribed format and for ensuring that these electronic data match the official hard copy laboratory report.

3.0 DESCRIPTION OF ELECTRONIC DATA MANAGEMENT COMPONENTS

The electronic environmental data management system facilitates effective management of investigation data for each specific task. This system provides for efficient upload of field parameters and laboratory analytical data, quality assurance, routine data analysis, and reporting. The system automates many of the routine tasks involved in data management. The details of data management activities are described below.

The backend of the environmental data management system consists of a relational database using Microsoft Access 2003. The Data Manager will be responsible for setting up the data structure, uploading laboratory data and entering field data into the database prior to the setup of an electronic data management system. Data collected from on-site laboratory facilities will be stored and managed in a yet to be decided manner.

A customized Database Management System (DBMS) may be developed specifically for the Site. The DBMS provides the basic user interface. The design master database is maintained on a file server which may be accessed by users at various workstations using the DBMS. Activities that may be performed by each individual granted access to the database depends on the rights (i.e., read only, read/write, administrator) granted to that user at login. The Data Manager is responsible for adding users to the system on an as-needed basis and for assigning access rights to all users. Normally, only data managers as directed by the Project Manager will be assigned administrator rights. This includes full read/write access to the database via the DBMS and the ability to add and delete users from the system. Personnel with responsibility for uploading laboratory data and entering field data into the database are assigned read/write access. All others, including managers and staff with the need to access the database, are assigned read-only rights. The Data Manager is also responsible for providing access to the database directly using MS Access to perform specialized operations that may not be available from the DBMS. Users to be granted direct access are selected by the data manager on a case-by-case basis as directed by the Project Manager. Copies of the design master database are distributed periodically to the project team at remote locations as directed by the Project Manager.

3.1 LABORATORY ELECTRONIC DATA DELIVERABLE

In addition to the hard-copy analytical data package, the laboratory prepares an Electronic Data Deliverable (EDD) containing all field sample and field quality assurance analytical results for each sample delivery group. Laboratory quality assurance samples such as method blanks, laboratory control samples, matrix spikes and surrogates will be requested in the EDD. The EDD format is specified in each laboratory bid package and will be produced by the laboratory as shown on Table 1. EDDs are output directly by the Laboratory Information Management System (LIMS) with additional electronic processing as necessary to produce the format shown on Table 1. Each EDD is provided to the data manager as an MS Access database with the laboratory's sample delivery group as the file name. This database contains one table called "Lab_Results" which contains the EDD for that sample delivery group. Lookup tables containing Valid Values Lists for those fields that require them (Table 1) are provided to the laboratory prior to the beginning of each task. The laboratory will put into place procedures to ensure compliance with the format requirements specified in Table 1 and the associated valid values lists.

It is the responsibility of the laboratory to ensure that the EDD matches the official hard copy laboratory report. The Data Manager performs quality control (QC) checks of the EDD prior to uploading the EDD to the database to verify laboratory compliance with this requirement. This check includes a 10 percent verification of all fields in the EDD against the hardcopy laboratory report. Further, the laboratory will verify that each record in the EDD is uniquely identified by the Primary Key fields presented above. The EDD may be transferred from the laboratory to the data manager via email attachment. Alternatively, the laboratory may set up a secure FTP site for posting and download of project EDDs.

In the event a laboratory is selected to provide analytical support that does not possess a LIMS and is unable to produce the EDD, alternate electronic tables will be evaluated for use, or their data will be hand entered into the database. The Project Chemist is responsible for ensuring that data to be entered into the database are clearly labeled and in a format specified by the Data Manager. The Data Manager is responsible for ensuring that these data are accurately entered into the database and for providing a 100% check of the hand entered data.

3.2 DATABASE STRUCTURE

Tables 2 through 5 list the structure, data types, and field descriptions for the primary tables of the database. Additionally, Table 6 provides the structures of the various lookup tables used in the database.

3.2.1 Sampling Sites

Each sampling location for which data are included in the database is described in the LDI table (Table 2). This table includes available information that is unique to that site such as site name, elevation and horizontal coordinates, screened interval, etc. The primary key for this table is the LocID field. For new sites, the Project Manager is responsible for providing the information required to update the Sites table to the Data Manager.

3.2.2 Analytical Results

Analytical results for field samples are contained in three related tables. Sample-specific information such as site identification, sample date, analytical method, field QC designation, etc. are included in the Samples table (Table 3), and data that are unique to each analytical result are included in the Tests (Table 4) and Results table (Table 5). The FLDSAMPID and SACODE make up the primary key for SAMPLES. Data that are pertinent to sample preparation and handling such as analytical method, analysis date, and laboratory sample identification is contained in the TESTS table. Four fields, FLDSAMPID, SACODE, ANMCODE, and RUN_NUMBER, are the primary keys for this table. Finally, data that are unique to each analytical result such as analyte label, CAS Number, and concentration are included in the

RESULTS table (Table 2-11). The primary keys for this table are FLDSAMPID, SACODE, ANMCODE, RUN_NUMBER, and PARLABEL. The SAMPLES and TESTS tables are related by FLDSAMPID AND SACODE (which are unique to the sample). The TESTS and RESULTS tables are related by FLDSAMPID, SACODE, ANMCODE, and RUN_NUMBER. The Data Manager will provide to the laboratory a list of valid values for each analyte and CAS Number to be quantified. For analytes that do not have an assigned CAS Number, the Data Manager will assign a unique code to be used in place of a CAS Number.

The analytical laboratory is responsible for providing the EDD to the Data Manager in the format prescribed in Table 1 for upload to the chemistry tables in the database. It is the responsibility of the Field Manager to provide copies of all completed chain of custody (COC) forms and field sampling records to the data manager and to ensure the accuracy of these forms. COC forms are used to verify completeness of laboratory EDDs. Field sampling sheets are used to enter sample data not included in the EDD such as site identification, sample matrix, field parameters, and type of sample (original, field duplicate, etc.).

3.2.4 Field Parameters

The field measurements will be maintained in the primary Samples, Test, and Results data structure tables described above. These samples will have the Method value of "Field".

3.2.5 Valid Values

In addition to the primary tables described above, a variety of lookup tables are employed in the database to provide lists of valid values for the fields in the primary tables. The lookup table structures are displayed in Table 6. These tables reduce data entry time and provide a measure of quality assurance by limiting the choices for data entry and upload to valid values. Further, referential integrity with cascading updates is maintained between the lookup tables and associated primary tables so that changes to valid values in the lookup tables are updated in all related records in the primary tables. Finally, a number of template tables in the database are used by the DBMS for data entry and import as well as for reporting purposes.

3.3 DATABASE MANAGEMENT SYSTEM

The DBMS consists of a compiled Windows XP (or later) application. The DBMS is completely self-contained, and therefore, it is not necessary to have MS Access or any other application installed on the workstation in order to execute. Once the initial setup is performed and the application has been run for the first time, the connection to the database is automatic requiring no user intervention.

The DBMS performs three primary functions. These include:

- Data Input,
- Analysis, and

- Reporting.

The core components of these functions are described briefly here. Additional modules may be added in the future depending on specific project needs.

3.3.1 Data Input

The data input module of the DBMS includes tools for importing a laboratory EDD, templates for entering sample identification details (such as sample depth and type of sample), and sampling location details (such as coordinates and well construction details) The required laboratory EDD structure is shown in Table 1.

3.3.1.1 Laboratory Data Import

A copy of the laboratory EDD is initially uploaded into a template table for review and quality checks. During import, the DBMS checks to ensure that the required table is present in the EDD and that the structure of this table is in accordance with Table 1. Additionally, the DBMS performs a series of integrity checks on the EDD to ensure that key violations will not occur when the flat file structure of the EDD is converted to the relational structure of the database. If errors are noted during this process, the DBMS provides the option of viewing the problem records, but the required changes must be made to the EDD outside of the DBMS environment prior to importing to the database. This would normally be accomplished by requiring the laboratory to submit a revised EDD. An original, unaltered copy of all laboratory EDDs will be maintained in the project's electronic file management system.

After the initial import is completed, the user is required to execute an option which checks all numeric values in the EDD to ensure that they fall within an acceptable site-wide range. Further, this procedure checks all fields for which valid values are required in the EDD against the appropriate lookup tables. If a value is encountered in the EDD that is not valid, a message is displayed asking the user to select a new value from a dropdown list of the lookup table contents, to delete that record from the template, or to continue with the import. Normally, one of the first two options would be chosen to either modify the syntax of the value or to abort import of that record. The third option would only be chosen if the user wishes to view the entire template before correcting the EDD. However, if this option is chosen, the DMBS will not allow the EDD to be appended to the database because referential integrity would be violated. A log of errors encountered during import and any changes made to the EDD is saved to the data directory in the form of a text file. The Project Manager and Project Chemist will be provided with copies of all import logs for the purpose of resolving errors encountered during import and preventing future syntax errors recorded by field staff on chain of custody forms.

Once the EDD has been successfully imported and checked, the user must review the EDD for quality assurance purposes prior to appending to the permanent chemistry tables. This may be performed either on-line using a spreadsheet-like grid provided by the DBMS, or the grid can be printed out and a check can be performed on paper. This review will consist of a 10 percent check of all fields in the database against the official hard copy laboratory report. If errors are encountered, then 100 percent of the records for that sample delivery group will be checked. After quality checks have been completed, and any errors are corrected and checked, the EDD will be uploaded to the permanent chemistry database tables.

The original EDD for each delivery group will be archived on the server and permanently backed up to an external medium using an automated backup system.

3.3.1.2 Manual Data Input

Field parameters are normally input manually from field records using data entry templates provided in the DBMS. Prior to opening the appropriate data entry template, the user is given the opportunity to specify default entries for text (such as measurement units) and date fields to minimize data entry errors and to limit repetitive data entry tasks. Other non-repetitive text fields may be selected from drop-down lists of valid values. Further, the DBMS checks each numeric value against a predetermined valid site-wide range for a given parameter. If sufficient history is available, the DBMS will also check to see if each value entered is within the historical range measured previously at that site, and prompts the user to verify entries that are outside of that historical range.

After data are entered into the appropriate template, the user performs quality checks of the data using the on-line grid provided in the DBMS which can optionally be printed out for paper comparison. 100 percent of the data entry is checked against the appropriate field records. After quality checks are performed and any corrections are made and checked, field parameters are appended to the permanent field parameters table.

3.3.1.3 Data Validation Entry

This section describes procedures for adding data validation qualifiers to the database that have been assigned as part of the validation process.

Once laboratory EDDs have been uploaded to the database and data validation has been completed, the Project Chemist updates the database based on the Data Validation Report. Two fields in the Results table are designated specifically for data validation. These are hold the validation flag, and the reason for the flag assignment in Data_Flag. The DBMS provides a Data Validation Query to facilitate manual entry of data validation information. For all results that are reviewed during data validation but for which no qualifier is assigned, a colon ":" is entered into both the flag and reason fields. The project chemist is responsible for ensuring that validation information entered into the database per the Data Validation Report. Additionally, after the information entered, the data validation query will be printed and 100 percent of the entered codes will be quality checked against the Data Validation Report.

For analytes that are assigned an "R" or rejected validation code, the numeric fields containing concentration, reporting limit and detection limit information are assigned a "Null" value. This is to ensure that rejected data are not inadvertently used during future data analyses.

In addition to changes based on rejected results as described above, other changes to the reported laboratory results (detection limits, concentrations, etc.) may be required as a result of data validation activities. For example, detection limits reported by the laboratory may be increased and a detected value changed to non-detect during data validation for some results that do not meet specific quality assurance guidelines. In these cases, changes to the database are performed by the Project Chemist during data validation entry in accordance with the data validation report. After any required changes are completed, 100 percent of the changes are quality checked.

After data validation entry for a given sample delivery group is completed in accordance with the data validation report as described above. The Is_Usable field in the Results table is set to "True" for each record during flag entry to indicate the data may be used for their intended purpose, subject to restrictions based on any assigned data validation codes assigned. The Is_Final field in the Results table is set to True for each record in the group. This is performed to indicate that the results contained in the record are final and are not expected to have additional updates. The DBMS provides a tool that allows the user to perform global updates of the Is_Final field for samples selected by the user. Changes made to the database subsequent to this point must be performed and documented in accordance with the QAPP Appendix B.

3.3.2 Analysis

The Analysis module of the DBMS provides a variety of pre-defined data queries, tools for performing ad-hoc database queries, a GIS spatial querying tool, time-series graphics, and basic statistical analyses including sampling event statistics, temporal statistics, and comparisons between sampling events. Other specialized data analyses statistics can be automated based on specific task needs. The results of all of the analysis options may be printed directly from the DBMS for inclusion in reports. At a minimum, analysis reports that form the basis of calculations included in report text or tables will be printed or exported to a portable document format file and included in the project file.

3.3.3 Reporting

A variety of customized tabular and/or cross-tabulated data reports may be produced from the DBMS for inclusion in investigation documents. These reports may be printed directly from the DBMS or, in some cases, can be exported to other formats including Adobe Acrobat, MS Word, MS Excel, comma delimited text, etc., if desired. To produce a report, the user is prompted to select a date range and/or sampling event that will indicate the time period of the report. In some cases, the user will also be prompted to provide information to be included in the report title. All reports may be reviewed on-line before printing. The original data report for all reports included in investigation submittals is maintained in the project file.

In addition to the predefined reports included in the DBMS, custom reports may be produced at the request of internal and/or external data users on an as-needed basis during the course of the project. Every effort will be made to meet these requests using final validated data. The DBMS provides a tool for loading, exporting, and printing custom reports created using industry standard data reporting software (Crystal Reports®). Requests from internal users should be forwarded to the Data Manager via email indicating the desired format and timeframe for delivery to ensure that the request is properly satisfied. The Data Manager or designee will respond via email indicating that the request will be fulfilled within the specified timeframe, within an alternative time frame, or that more information is necessary to generate the desired report.

Prior to delivery of electronic project data to external users, the Data Manager will contact the anticipated user(s) to obtain a specification for the desired data format. Every reasonable effort will be made to meet the specified formatting requirements.

3.4 GENERAL DATABASE MAINTENANCE PROCEDURES

3.4.1 Database Changes

Infrequently, changes may be required to the database after data from field records are entered and checked or after the Is_Final field in the Results table is set to "True". Changes of this nature are only performed under the direct supervision of the Data Manager and should be kept to an absolute minimum. When a change of this nature is required, all assigned DBMS users will be notified via e-mail of the change. It is the responsibility of the data manager to ensure that the appropriate notifications in accordance with this section are made. Assigned users are responsible for notifying individuals for whom they have provided database output of any such changes to the database.

3.4.2 Database Distribution

Ideally, only one copy of the database would be maintained on a central server, and all users would access the same database via client network connections using the DBMS. Practically, because users may need to query the database from locations where access to the database server is limited, it will be necessary to distribute copies of the database to specific users. As a quality assurance measure, the number of copies of the database that are distributed is kept to a minimum, and a strict inventory of those copies distributed is maintained by the Data Manager. Further, updates to the database are only authorized for the design master database installation.

Periodically, copies of the database will be distributed to the appropriate users who will be responsible for replacing their existing copy of the database with the newer version. Distribution of databases copies will normally be performed when significant updates to the database are completed.

The Data Manager will be responsible for distributing updated databases to the appropriate users. Individual users are responsible for replacing their copies of the database with the appropriate updates provided by the Data Manager.

In addition to full database copies, subsets of the database may be transmitted by the Data Manager to the appropriate investigation team members on an as-needed basis in a variety of formats including Access, Excel, Word, etc.

3.4.3 Sample Identification

The sample nomenclature scheme is described in the FSP.

3.5 MANAGEMENT OF PROJECT SPATIAL DATA

Spatial coverage (maps) generated during the project will be prepared using ArcGIS® and will be provided in final deliverables to external users in hard copy and electronically in ArcGIS 9.x format. Investigation data posted on GIS maps will either be generated via a direct link from ArcGIS to the underlying Access database or from tables generated by the database that are converted to image files for posting on the GIS drawings. Spatial data used to create shape files for sampling locations will be generated by a direct link to the project database. Metadata with respect to spatial coverage will be FDGC compliant and will be maintained in the ArcGIS project. The GIS component of the DBMS mentioned in Section 4.3.2 will be linked directly to a subset of the complete GIS coverage provided in ArcView project files. This spatial querying tool is strictly for online analysis and is not to be used for map production.

3.6 DATABASE REPORTS

At various times throughout the project, database reports may be requested by various data users. Every effort will be made to meet these requests with final validated data. However, if any preliminary data are reported, the data display will clearly indicate that the data are preliminary and subject to change based on validation.

3.6.1 Internal Requests for Reports

Internal data users will be able to run most data reports from the DBMS. Unique requests for data reports will be submitted to the Data Manager or specified designee. Such requests should be made in writing to ensure that request is properly satisfied (i.e., brief email message). The Data Manager or specified designee will respond with a written message indicating that the request will be fulfilled within the specified timeframe, within an alternate timeframe, or that more information is necessary to generate the desired report.

4.0 DATA SECURITY

The subsections below summarize the procedures that will be implemented to ensure the retention and protection of field records and electronic data.

4.1 FIELD RECORDS

Original copies of all COC forms (those indicating samples were relinquished by field personnel and those indicating sample receipt at the laboratory), sample collection sheets, and shipping airbills will directed to the Project Manager or designee after completion of field activities. Copies of these records will be presented in the associated project reports detailing field activities. In addition, all original records will be retained in either hardcopy or Adobe Acrobat .pdf format in the central project files. The central project files will be maintained in the contractor's office until such time that the files are archived.

4.2 ELECTRONIC PROJECT FILES

All electronic files will be retained in an electronic file management system. Electronic files will routinely be backed-up. In order to facilitate file retrieval as needed, it is suggested that every effort be made to specify the file path, name, date, and time in the document footer. Unaltered copies of all original external data deliverables (i.e., electronic laboratory data) will be retained in the electronic file management system. Sensitive documents may be password protected as necessary. Final electronic documents will be archived with a read-only attribute to prevent inadvertent modification. To prevent unauthorized access, all electronic documents generated during this investigation will be maintained on local file servers or corporate intranets behind a corporate firewall, or on secure internet sites that require password authorization for access.

4.3 DATABASE SECURITY

Measures that will be taken to prevent unauthorized access to or modification of the database via the DBMS are described in Section 4.0. Strict control of the users allowed access the database via Microsoft Access will be maintained. The design-master database and internal replica will be maintained on a file server behind the corporate firewall to further prevent unauthorized access. For project collaboration purposes, subsets of the complete database may be posted on a secure internet site requiring password authorization to access. The design master database will undergo regular backup in accordance with corporate policies and will periodically archived for offsite storage in a secure location.

5.0 RECORD PRESERVATION

All records and documents that relate to the work conducted for the duration of this project will be preserved for the duration of the project and for at least seven years after commencement of construction of any remedial action.

Table 1
LABORATORY EDD TABLE STRUCTURE

Field Name	Data Type	Description
FLDSAMPID*	Text	Field Sample Identification (See section 3.3).
LABSAMPID*	Text	Laboratory Sample Identification.
LOGDATE*	Date/Time	Date and time of sample collection
REC_DATE	Date/Time	Date and time that sample was received by laboratory.
EXTDATE	Date/Time	Date and time of laboratory sample extraction for this FLDSAMPID, ANMCODE, PARLABEL, and RUN_NUMBER.
ANADATE	Date/Time	Date and time that this FLDSAMPID, ANMCODE, PARLABEL, and RUN_NUMBER was analyzed by the laboratory.
ANMCODE*	Text	Analytical Method (from valid values list).
SAMP_FRACTION	Text	Fraction of sample analyzed (T – Total, D – Dissolved) (from valid values list).
EXMCODE*	Text	Code from method used to prepare or extract a sample; from valid values list.
PARLABEL*	Text	Parameter Label (from valid values list).
RUN_NUMBER*	Number	Numerical code applied to repeat analyses of the same sample using the same method on the same day.
MATRIX*	Text	Sample matrix type; from valid values list.
PARVAL	Number	Concentration of the PARLABEL expressed in UNITS. PARVAL = 0 if PARVQ = "ND"
PRECISION	Number	Number indicating the precision (number of digits after the decimal point) that applies to the reported PARVAL, MDL, and RL fields.
RL[1]	Number	Concentration of Reporting Limit (also known as quantitation limit) in UNITS.
MDL	Number	The concentration of Method Detection Limit in UNITS.
UNITS	Text	Concentration units used in PARVAL, RL and MDL (from valid values list).
DILUTION	Number	Laboratory dilution factor for PARVAL, RL, and MDL (1 - No dilution).
LAB_QC_FLAG	Text	Used by the laboratory to indicate samples that may be affected by laboratory QA/QC issues. At a minimum, the laboratory will use this field to enter a unique flag to indicate that the associated value reported is below the RL concentration.
LABLOTCTL	Text	Batch designator for a group of environmental samples and their associated QC samples prepared together.
BASIS	Text	Basis for reporting solid sample results (e.g. "wet" or "dry"); from valid values list.
PRCCODE	Text	Analytical suite classification; from valid values list.
PARVQ	Text	Data qualifier for result (not laboratory or data validator qualifier); from valid values list.

Table 1
LABORATORY EDD TABLE STRUCTURE (continued)

Field Name	Data Type	Description
EXPECTED	Number	Target result for field duplicates, ambient blanks, equipment blanks, and trip blanks.
SACODE*	Text	Sample type (e.g. normal environmental or QA/QC); from valid values list.
ANALOT	Text	Batch designator for a group of environmental samples and their associated QC samples analyzed together.
SAMPNO*	Text	Sequential sample number assigned to sample of a given type collected at the same location on the same day.
LABCODE*	Text	Code for analytical laboratory performing analyses; from valid values list.
REC_DATE	Date/Time	Date the sample was received at the lab
ANALOT	Text	Analyzed lot is the batch designator of a group of environmental samples and associated QC samples analyzed together
SAMPNO	Number	Numerical identifier for the samples taken
SDG	Text	Lab created code to identify a group or selection of samples
LAB_DQT	Text	Data qualifier type, coded value indicating the specific QAPP or DQO document which the entered performance criteria data originates
PERCENT_RECOVERY	Number	Calculated recovery for the spiked and surrogate analyte.
RPD	Number	Measure of variability adjust for the magnitude of observations. This is used to assess total analytical precision of duplicate measurements
UPPER_RPD	Number	Upper Relative Percent Difference
UPPER_ACCURACY	Number	Upper control limit of percent recovery as measured for a known target analyte spiked into a QC sample
LOWER_ACCURACY	Number	Lower control limit of a percent recovery as measured for a known target analyte spiked into a QC sample
SPIKE_ADDED	Number	Final concentration of an analyte spiked into a sample
SDG	Number	Analyzed lot is the batch designator of a group of environmental samples and associated QC samples analyzed together
LAB_DQT	Number	Numerical identifier for the samples taken
PERCENT_RECOVERY	Number	Lab created code to identify a group or selection of samples
RPD	Number	Data qualifier type, coded value indicating the specific QAPP or DQO document which the entered performance criteria data originates

* Primary Key Field

[1] The Reporting Limit (RL) for a given analyte is the smallest concentration that can be reported with a specific degree of confidence (approximately +/- 25%).

Table 2
LDI TABLE STRUCTURE

Field Name	Data Type	Description
LOCID*	Text	Sampling location name.
LTCCODE	Text	Location type; from valid values list.
LPRCODE	Text	Location proximity code; indicates whether sampling location is within or outside of installation boundaries; from valid values list.
NCOORD	Number	Northing coordinate of LOCID location.
ECOORD	Number	Easting coordinate of LOCID location.
CRDTYPE	Text	Type of coordinate system used from surveying location; from valid values list.
CRDMETH	Text	Survey method; from valid values list.
CRDUNITS	Text	Units of measure for the surveyed northing (NCOORD) and easting (ECOORD) coordinates; from valid values list.
ESTDATE	Date/Time	Date that sampling/testing location was established; for monitor wells, assumed to be installation date.
ESCCODE	Text	Code for company that established sampling location.
DRLCODE	Text	Drilling company code; from valid values list; use "NA" if not applicable (i.e., not a borehole/well).
CMCCODE	Text	Construction method code identifying how a borehole was constructed; from valid values list.
ELEV	Number	Ground surface elevation (soil, groundwater, sediment locations) or water surface (surface water locations).
ELEVMETH	Text	Elevation measuring method; from valid values list.
ELEVUNITS	Text	Elevation units; from valid values list
DEPTH	Number	Borehole depth (feet below ground surface); includes boreholes drilled to install monitoring wells.
BHDIAM	Number	Borehole diameter (inches).
DATUM	Text	Vertical survey datum.
LOCDESC	Text	Brief text describing the sample location.
SRVY_SRC	Text	Survey contractor used for horizontal coordinates.

* Primary Key Field

Table 3
SAMPLES TABLE STRUCTURE

Field Name	Data Type	Description
LOCID	Text	Sampling location name.
LOGDATE	Date/Time	Date and time that sample was collected or field measurement was made (LOGDATE/LOGTIME).
MATRIX	Text	Sample matrix type; from valid values list.
SBD	Number	Depth to top of sample interval (feet below ground surface for soil samples); enter zero for groundwater samples.
SED	Number	Depth to bottom of sample interval (feet below ground surface for soil samples); enter zero for groundwater samples.
SACODE*	Text	Sample type (e.g., normal environment or QA/QC); from valid values list.
SAMPNO	Text	Sequential sample number assigned to sample of a given type collected at the same location on the same day.
LOGCODE	Text	Code for company collecting samples or performing field test; from valid values list.
SMCODE	Text	Sampling method used to collect sample; from valid values list.
FLDSAMPID*	Text	Field sample identification.
COOLER	Text	Number assigned to cooler containing VOC fraction of sample; will always be cooler No. 1 of a shipment.
ABLOT	Text	Ambient blank field lot identification; applies to environmental samples associated with ambient blanks; does not apply to blanks themselves.
EBLOT	Text	Equipment blank field lot identification; applies to environmental samples associated with equipment blanks; does not apply to blanks themselves.
TBLOT	Text	Trip blank field lot identification; applies to environmental samples associated with ambient blanks; does not apply to blanks themselves.
EVENTCODE	Text	Indicates sampling event during which the sample was collected.
SAMP_FRACTION	Text	Indicates "T" total or "D" dissolved sample.
REMARKS	Text	Text comments or descriptions about the sample.

* Primary Key Field

Table 4
TESTS TABLE STRUCTURE

Field Name	Data Type	Description
FLDSAMPID*	Text	Field sample identification.
SACODE*	Text	Sample type (e.g., normal environment or QA/QC); from valid values list.
LABCODE	Text	Code for analytical laboratory performing the analyses; from valid values list.
ANMCODE*	Text	Method used from sampling analysis; from valid values list.
EXMCODE	Text	Code from method used to prepare or extract a sample; from valid values list.
RUN_NUMBER*	Number	Numerical code applied to repeat analyses of the same sample using the same method on the same day.
LABSAMPID	Text	Laboratory sample identification; space character entered for field tests.
EXTDATE	Date/Time	Date and time the laboratory extracted the sample for analysis
ANADATE	Date/Time	Date and time the laboratory analyzed the sample
LABLOTCTL	Text	Batch designator for a group of environmental samples and their associated QC samples.
BASIS	Text	Basis for reporting solid sample results (e.g., "wet" or "dry"); from valid values list.
REC_DATE	Date/Time	Date the sample was received at the lab.
ANALOG	Text	Analyzed lot is the batch designator of a group of environmental samples and associated QC samples analyzed together
SAMPNO	Number	Numerical identifier for the samples taken
SDG	Text	Lab created code to identify a group or selection of samples

* Primary Key Field

Table 5
RESULTS TABLE STRUCTURE

Field Name	Data Type	Description
FLDSAMPID*	Text	Field sample identification.
SACODE*	Text	Sample type (e.g., normal environment or QA/QC); from valid values list.
ANMCODE*	Text	Method used for sample analysis; from valid values list.
RUN_NUMBER*	Number	Numerical code applied to repeat analyses of the same sample using the same method on the same day.
PARLABEL*	Text	Parameter (analyte) name; from valid values list.
PRCCODE	Text	Analytical suite classification; from valid values list.
PARVAL	Number	Concentration of parameter expressed in units specified in UNITS field.
PARVQ	Text	Data qualifier for result (not laboratory or data validator qualifier); from valid values list.
PRECISION	Number	Number indicating the precision (number of digits after the decimal point) that applies to the reported PARVAL, MDL, and RL fields.
EXPECTED	Number	Target result for field duplicates, ambient blanks, equipment blanks, and trip blanks.
MDL	Number	Method detection limit; represents smallest quantity of analyte that can be detected for a particular method.
RL	Number	Reporting limit as specified in project Quality Assurance Project Plan (QAPP).
UNITS	Text	Concentration units used for PARVAL, MDL, and RL fields; from valid values list.
DILUTION	Number	Laboratory dilution factor for result in PARVAL, MDL, and RL fields (1- no dilution).
DQTYPE	Text	Data qualifier type; from valid values list.
EPA_FLAGS	Text	Data validation qualifier.
Lab_QC_flag	Text	Qualifier assigned by the analytical laboratory.
QAPPFLAGS	Text	Coded value applied to PARVAL according to QAPP requirements.
QAPPFLAGS_REAS	Text	Coded value explaining reason(s) for QAPPFLAGS assignment.
USEABLE	Yes/No	Boolean flag indicating whether an individual result is the most appropriate for this FLDSAMPID, ANMCODE, PARLEVEL, AND RUN_NUMBER.
IS_FINAL	Yes/No	YES indicates result is suitable for its intended use, subject to data qualifiers.

Table 5
RESULTS TABLE STRUCTURE (continued)

Field Name	Data Type	Description
LAB_DQT	Text	Data qualifier type, coded value indicating the specific QAPP or DQO document which the entered performance criteria data originates
PERCENT_RECOVERY	Number	Calculated recovery for the spiked and surrogate analyte.
RPD	Number	Measure of variability to adjust for the magnitude of observations. This is used to assess total analytical precision of duplicate measurements
UPPER_RPD	Number	Upper Relative Percent Difference
UPPER_ACCURACY	Number	Upper control limit of percent recovery as measured for a known target analyte spiked into a QC sample
LOWER_ACCURACY	Number	Lower control limit of a percent recovery as measured for a known target analyte spiked into a QC sample
SPIKE_ADDED	Number	Final concentration of an analyte spiked into a sample

* Primary Key Field

Table 6
LOOKUP TABLE STRUCTURES

Field Name	Data Type	Description
LOOKUP_ANMCODE		
ANMCODE*	Text	Code indicating method used to analyze sample.
DESCRIPTION	Text	Full name for ANMCODE.
LOOKUP_BASIS		
BASIS*	Text	Code describing whether sample results are reported on a wet or dry basis. Enter "X" for water, air, gas, QC samples.
description	Text	Full name for BASIS.
LOOKUP_CALCMETH		
CALCMETH*	Text	Code indicating calculation method used for calculating hydraulic conductivity.
Description	Text	Full name for CALCMETH.
LOOKUP_CRDMETH		
CRDMETH*	Text	Code describing method used to establish coordinates (e.g., survey, GPS, estimated, etc.).
Description	Text	Full name for CRDMETH.
LOOKUP_CRDTYPE		
CRDTYPE*	Text	Code describing the type of coordinate system used (e.g., NAD).
Description	Text	Full name of CRDTYPE.
LOOKUP_DQTYPE		
DQTYPE*	Text	Code describing data qualifier type (e.g., project specific, EPA, etc.).
description	Text	Description of DQTYPE code.
LOOKUP_ELEVMETH		
ELEVMETH*	Text	Code describing the method used to determine a location's elevation. Used in LDI table.
Description	Text	Full name for ELEVMETH.
LOOKUP_LABCODE		
LABCODE*	Text	Code identifying the laboratory that completed the analyses. Used in TESTS table.
LOOKUP_LTCCODE		
ltccode*	Text	Code for sampling location type.
Description	Text	Description of LTCCODE.

Table 6
LOOKUP TABLE STRUCTURES (continued)

Field Name	Data Type	Description
LOOKUP_MATRIX		
matrix*	Text	Code describing the type of sample matrix.
Description	Text	Full name for MATRIX.
LOOKUP_PARLABEL		
parlabel*	Text	Code describing the analyte. Used in RESULTS table.
DESCRIPTION	Text	Full name of PARLABEL.
LOOKUP_PARVQ		
parvq*	Text	Code describing if analyte was detected, not detected, or detected at trace concentrations.
Description	Text	Description of PARVQ.
LOOKUP_PRCCODE		
PRCCODE*	Text	Code describing the type of analyte.
Description	Text	Description of PRCCODE.
LOOKUP_QAPPFLAGS		
qappflags*	Text	Code describing the data validation flag.
Description	Text	Description of QAPPFLAGS.
LOOKUP_SACODE		
sacode*	Text	Code describing type of sample.
Description	Text	Description of SACODE.
LOOKUP_SAQCODE		
saqcode*	Text	Code identifying the sole source aquifer in which the well is completed.
Description	Text	Full name of SAQCODE.
LOOKUP_SMCODE		
smcode*	Text	Code describing sampling method.
Description	Text	Description of SMCODE.
LOOKUP_SPCODE		
sPcode*	Text	Code indicating placement information for the site.
Description	Text	Full name for SPCODE.
LOOKUP_TESTMETH		
TESTMETH	Text	Code indicating type of aquifer test performed.
DESCRIPTION	Text	Full name of TESTMETH.

Table 6
LOOKUP TABLE STRUCTURES (continued)

Field Name	Data Type	Description
LOOKUP_UNITS		
UNITS*	Text	Code for parameter measuring units
description	Text	Full name for UNITS.

Attachment 2
Analytical Data Validation

ATTACHMENT 2
ANALYTICAL DATA VALIDATION

QAPP
Investigation and Removal Action
Moline Street PCB Site

Attachment 2 — Analytical Data Validation

List of Tables

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Attachment 2 — Analytical Data Validation

1.0 PURPOSE AND SCOPE

This standard operating procedure (SOP) describes procedures to be used to conduct an independent review of environmental analytical laboratory data so that data of known and documented quality will be used for all decision making. Procedures for review of field data are included in the FSP.

This SOP includes two levels of data review, evaluation of sample-specific parameters and evaluation of laboratory performance parameters. All environmental data generated will receive at least an evaluation of sample-specific parameters. In addition, data intended for stringent uses (e.g. litigation support, etc.) will also receive a review of laboratory performance parameters.

This SOP addresses the protocols that will be followed for the sample-specific parameters and laboratory performance parameters data review levels. The review of sample-specific parameters is described in Section 31. The review of laboratory performance parameters is discussed in Section 3.2. In addition, Section 5 discusses the associated documentation.

This SOP was developed using guidance from the USEPA Contract Laboratory Program (CLP) National Functional Guidelines for Organic Data Review (June, 2008).

2.0 RESPONSIBILITIES AND QUALIFICATIONS

The URS Project Manager or URS Project QA Manager has the overall responsibility for implementing this SOP. They will be responsible for assigning appropriate environmental staff to implement this SOP and for ensuring that the procedures are followed.

All personnel performing these procedures are required to be familiar with environmental data, its generation, and its reporting. In addition, all personnel are required to have a complete understanding of the procedures described within the SAP and this SOP, as applicable. Activity-specific training regarding these procedures will be provided by the URS Project QA Manager or designee to personnel implementing this SOP, as necessary.

All environmental staff are responsible for reporting deviations from this SOP to the URS Project Manager or URS Project QA Manager.

3.0 DATA REVIEW PROCEDURES

As noted in Section 1.0, all analytical data used for reporting and environmental decision making will receive a review independent of the laboratory to assure that data are of known and documented quality.

The review of sample-specific parameters includes evaluating parameters that are sample-related. These include: case narrative comments, chain-of-custody and sample condition upon receipt, holding times, method blank results, surrogate recoveries, matrix spike recoveries, laboratory duplicate or spike duplicate analysis, and results for field quality control samples (e.g. field duplicates, and rinsate blanks). The sample-specific review is described in Section 3.1. Sample-specific parameters will be reviewed and evaluated for all data.

If data are intended for stringent uses (e.g. litigation support, etc.) a review of laboratory performance parameters will be performed. The review of laboratory performance parameters includes evaluating operations that are in the control of the laboratory, but are independent of the field samples being analyzed. These include: initial calibration, initial and continuing calibration verification, laboratory control sample analysis, compound identification, result calculation (i.e., quantitation), data transcription (i.e., verification), and method-specific quality control requirements (e.g. thermal stability, tuning, resolution, mass calibration, interference check sample analysis as applicable to the method). Evaluation of these parameters provides an assessment of overall system performance. The review of laboratory performance parameters is discussed in Section 3.2. For stringent use data, laboratory performance parameters will be reviewed for all data (per method).

During the data review process, data validation qualifiers, as defined in Table 1, will be assigned to the results, as necessary, to indicate any potential limitation on the use of the data. In addition, data qualifier codes and bias codes as defined in Table 2 will be added to the results to indicate the reason(s) for qualification and the associated bias direction, if discernable. Data validation narratives will be generated which document the results of all data review activities, all data qualification assigned, and any limitations on the use of the data.

3.1 REVIEW OF SAMPLE-SPECIFIC CRITERIA

The review of sample-specific criteria includes evaluating parameters that are sample-related. Each of the subsections below describes how each parameter is evaluated. While most parameters to evaluate are pertinent to all methods, some are method-specific (e.g., see Section 3.1.6). In general, the hierarchy for acceptance criteria used to evaluate each parameter is as follows:

- Criteria specified in the QAP.
- Method-specified acceptance criteria.
- Acceptance ranges based on laboratory historical data.

According to this hierarchy, a parameter is first evaluated against the requirements set forth in the QAPP. If the criteria are not specified in the QAPP, then the parameter is evaluated against the requirements stated in the analytical method. If the method does not specify acceptance criteria, results for the parameter are compared to acceptance ranges based on laboratory historical data.

No recalculation of results from the raw data or transcription error checking will be performed during the review of the sample-specific criteria as recalculation and transcription error checking is completed during the review of laboratory performance criteria.

3.1.1 Case Narrative Comments

The data validation process begins with an examination of the case narrative. Any analytical problems noted in the case narrative are noted in the data validation narrative along with a summary of the effect on the usability of the data.

3.1.2 Chain-of-Custody and Sample Receipt

The chain of custody (COC) documentation, sample receipt, and log-in information are reviewed. The analytical results received are compared against those requested on the COC form. Any COC problems or discrepancies and any problems noted by the laboratory with regard to sample condition upon receipt are noted in the data validation narrative along with a statement of the effect on the usability of the data.

3.1.3 Holding Times

Collection-to-analysis holding times are calculated by computing the difference between the sample collection date and the sample analysis date. The collection dates are found on the COC and analysis dates are reported on the analysis run logs. The holding times are compared to the acceptance limits contained in the SAP and/or respective analytical methods, as applicable. Results for analyses not performed within holding time limits will be qualified as estimated ("J/UJ"). If the holding time is grossly exceeded (more than two times the holding time limit), the data reviewer should use professional judgment to evaluate the need to reject non-detectable results.

A reason code of "HT" will be assigned to all results qualified or rejected on the basis of holding times.

3.1.4 Blanks

Blank analysis results are used to assess the existence and magnitude of contamination problems. If a problem exists with any blank, the reviewer will evaluate whether there is an inherent variability in the data for the entire data set or if the problem is an isolated occurrence not affecting other data.

Blanks should be analyzed for every matrix and every batch, or at a frequency of 5 percent, which ever is more frequent. The results for all blanks should be plotted by the laboratory's QA department to determine that each blank result falls within the recommended tolerance limits of ± 3 standard deviations.

Metals and Radiological Parameters

The results for method blanks will be reviewed. Sample results for analytes detected in an associated blank at concentrations <5x the equivalent blank concentration will be qualified as non-detect (U). For the common organic laboratory contaminants (i.e., acetone, methylene chloride, 2-butanone, cyclohexane, and phthalates), sample results <10x the concentration in the associated blank will be qualified as non-detect (U). The sample result will be qualified as non-detect at the reported concentration if the reported concentration is greater than the reporting limit (>RL) and the reported concentration becomes the "effective" RL or as non-detect (U) at the reporting limit if the reported concentration is <RL and the MDL becomes the reported concentration. Method blanks are associated with the samples in the same sample preparation/extraction batch.

A reason code of "MB" will be assigned to all results qualified on the basis of method blank or continuing calibration blank results, respectively. For results qualified as non-detect, the bias direction is considered to be indeterminate as the reporting limit is adjusted accordingly.

3.1.5 Matrix-Dependent Quality Control

Matrix dependent quality control (QC) samples are used to evaluate how the sample matrix affects the accuracy and precision of the analytical results.

In order to evaluate how the site-specific sample matrix affects the accuracy of the analysis; the laboratory will spike one or two additional aliquots of a field sample with known amounts of target analytes and prepare the spiked samples in a fashion identical to that of the field samples. The amount of each spiked analyte recovered can be used to infer the accuracy of the analysis on the site-specific sample matrix.

To assess the precision of the analysis on the site-specific sample matrix, a laboratory duplicate or spike duplicate sample is prepared. A laboratory duplicate sample is a laboratory split of a homogenized environmental sample that is prepared and analyzed in a manner identical to that of the original sample. A matrix spike duplicate is similar with the exception that both aliquots are spiked with known amounts of target analytes. The closeness of the agreement between the two results can be used to infer the precision of the analysis on the site-specific sample matrix.

The subsections below describe how the results for matrix QC samples will be evaluated.

3.1.5.1 Matrix Spike (MS) Analysis

The matrix spike results, expressed as percent recovery of the spiked analytes, are used to assess effects of the general sample matrix on the accuracy of the analysis. Samples identified as field blanks should not be used for MS analyses. At least one MS should be analyzed for every matrix, every batch, or for every 20 samples (5 percent of samples), whichever is more frequent. A matrix spike is not required for equipment blanks.

The matrix spike recoveries are compared to the appropriate acceptance ranges per Section 3.1 when the native sample concentration is less than four times the spike level. When native sample analyte concentrations are ≥ four times the spiking concentration, the results are considered to be inappropriate for assessing accuracy. The reviewer should also be aware that a matrix spike recovery may be outside acceptance limits when the parent sample was quantified by method of standard additions but the matrix spike was not. In such a case, the matrix spike recovery is not an appropriate measure of accuracy. Data associated with matrix spike recoveries that are outside the acceptance range will be qualified as follows using guidance from Functional Guidelines.

- If an analyte matrix spike recovery exceeds the upper limit of the acceptance range, suggesting a potential high bias in sample results, positive results for that target analyte in all associated samples are qualified as estimated ("J"); whereas, non-detect results for that analyte are considered to be acceptable for use without qualification. For organic methods, this qualification is limited to the parent sample.
- If an analyte matrix spike recovery is below the lower limit of the acceptance range, but ≥10% for organics, suggesting a potential low bias in sample results, both positive and non-detect results for only the parent sample for organic methods are qualified as estimated ("J/UJ").
- If an analyte matrix spike recovery is <10% for organics, non-detect results are qualified as unusable ("R") and positive results are qualified as estimated ("J") per Functional Guidelines guidance.

If a matrix spike duplicate is also prepared, the reviewer must use professional judgment and consider the recoveries for both the matrix spike sample and the matrix spike duplicate sample prior to assigning data qualifiers for inorganic data. All instances in which professional judgment is used to assign data qualifiers will be detailed in the individual data review narratives.

The reviewer should note that for organic data, no qualification of associated samples in the batch or data package will be performed on the basis of matrix spike recoveries alone. The data reviewer should use professional judgment and consider the results of other QC measures such as surrogate recoveries in conjunction with MS/MSD results to determine the need for extending qualification for the affected analytes to the other associated samples.

A reason code of "MS" will be assigned to all results qualified as estimated or unusable (rejected) on the basis of matrix spike and/or matrix spike duplicate recoveries. The assigned bias code will reflect the inferred bias direction.

3.1.5.2 Laboratory Duplicate (LD) Sample Analysis

Duplicate Analysis (matrix duplicate or spiked duplicate)

Duplicate analyses are indicators of laboratory precision based on each sample matrix. Samples identified as field blanks should not be used for duplicate analyses. At least one duplicate should be analyzed for every matrix, every batch, or for every 20 samples (5 percent of samples), whichever is more frequent.

The duplicate and spike duplicate sample analysis results are used to evaluate the precision of the laboratory analyses. Laboratory duplicate or spike duplicate results are evaluated using concentration dependent evaluation criteria.

- When both results are > 5x RL, compare the relative percent difference (RPD) between the sample results to a criterion of ≤20% for aqueous samples and ≤35% for soil and sediment samples.
- If either sample concentration is ≤ 5x RL, compare the absolute difference between the results to a criterion of ≤1x the greater RL for aqueous samples and ≤2x the greater RL for soil and sediment samples.

All evaluations are done using the higher RL and the RL is used in calculating the absolute difference for a non-detect result. If the applicable duplicate evaluation criterion is not met for an analyte, all associated sample data for that analyte will be qualified as estimated (J/UJ).

A reason code of "D" will be assigned to all results qualified on the basis of laboratory duplicate or spike duplicate results. A bias direction of indeterminate will be assigned to results qualified on the basis of duplicate results.

3.1.6 Method-Specific Quality Control Measures

The individual methods include method-specific QC measures. The procedures used to evaluate the results obtained for method-specific quality control measures are described below.

Any use of professional judgment will be explained in the data validation report.

Organic Method Specific QC Measures

For organic methods, method-specific QC measures may include surrogate compound recovery and internal standard performance. Evaluation procedures for each of these QC measures are described below.

Surrogate Spike Compound Recovery

The surrogate recoveries obtained for each sample analysis for which surrogates were analyzed will be compared to the acceptance range specified in the SAP, method, or that provided by the laboratory, as appropriate (per Section 3.1). Results for analytes in the sample associated with surrogate recoveries outside the acceptance range will be qualified as follows:

- If the surrogate recovery is greater than the upper acceptance limit for any surrogate (for semivolatile organics by GC/MS, two or more surrogates in either fraction must be high), suggesting a potential high bias in reported results, all positive results for associated analytes in that sample are qualified as estimated ("J") whereas non-detect results are considered to be acceptable for use without qualification.
- If the surrogate recovery is < the lower acceptance limit but ≥10% (for semivolatile organics by GC/MS, two or more surrogates in either fraction are out with at least one of them being less than the lower limit but ≥10%), suggesting a potential low bias in reported results, positive and non-detect results for associated analytes in that sample are qualified as estimated ("J" or "UJ").
- If any surrogate recovery is <10%, positive results for associated analytes in that sample are qualified as estimated ("J") whereas associated non-detect results are qualified as unusable ("R").

It is important to note that professional judgment may be utilized in assigning data qualification especially for methods in which more that one surrogate compound is used or in which there may have been multiple reasons for qualification on an individual result, or there may have been multiple analyses of the same sample. The data review narrative will detail any instance in which professional judgment was used.

A reason code of "SUR" will be assigned to all results qualified or rejected on the basis of surrogate recoveries. An appropriate bias code will be assigned.

3.1.7 Field Quality Control Samples

The types of field quality control samples that will be collected under this SAP include field duplicates, field replicates, blind duplicates, standard reference material samples, rinsate blanks, field blanks, and trip blanks. The evaluation for each type of field quality control sample is described below.

Field Duplicate Agreement (Organic Analyses)

Field duplicate sample results will be used as an indication of overall precision (i.e., field and laboratory precision) and/or the representativeness of the samples to the medium sampled.

Analytical results obtained for field duplicate sample pairs are compared to each other using the concentration dependent criteria described below.

- When both the sample and duplicate values are >5xRL, acceptable sampling and analytical precision is indicated by an RPD between the results of ≤30% (≤50% for soil samples).

- Where the result for one or both analytes of the field duplicate pair is <5xRL, satisfactory precision is indicated if the absolute difference between the field duplicate results is <2xRL (<3.5xRL for soil samples).

All evaluations are done using the higher RL and the RL is used for calculating the absolute difference for non-detect results. If the above criteria are not met for an analyte, all associated sample data for that analyte should be qualified as estimated ("J/UJ"). If a collective assessment is being performed, all results for that analyte in a sample delivery group or sampling episode are qualified as estimated ("J/UJ").

A reason code of "FD" will be assigned to results qualified as estimated on the basis of field duplicate agreement.

Confirmation Agreement

For soil sample analysis, a direct comparison between the field analysis data and laboratory confirmation analyses will be performed by evaluating the % difference between the measured concentrations. Acceptable % difference values would be between -25% and 25%, or near the middle of the X-axis of the data if plotted. Additionally, by comparing a range of field-screening results with laboratory results and establishing a correlation coefficient, a determination can be made about the adequacy of the field-screening confirmation results. For confirmation/verification, 20% of the field samples will be randomly selected for laboratory analysis in an attempt to submit soil samples with a wide range of PCB concentrations. The field analysis data will be compared to the laboratory data to assess precision of the results. A linear least squares regression analysis will be performed on the samples to assess the correlation of field analysis results with laboratory results with the field analysis results as the dependent variable. A correlation with a 99% confidence level or better is the criterion for acceptable agreement. This corresponds to a correlation coefficient of 0.874 or higher. This curve will be used to calculate site-specific laboratory equivalent values for sample results. This procedure is very much analogous to the inductively-coupled plasma interference correction equations used to correct inductively-coupled plasma results for matrix interferences. If a representative range of PCB concentrations is available for comparison, but the correlation coefficient is not initially met, 50% of the field samples not previously submitted for confirmation will be sent to the laboratory for analysis. If the revised correlation coefficient reflective of the larger sample population is still not met, the remaining field samples will be sent to the laboratory for analysis.

Rinsate Blank Results

The results for rinsate blanks reported in the data package will be reviewed. Sample results for analytes detected in an associated rinsate blank at concentrations <5x the equivalent blank concentration (<10x for common laboratory contaminants) will be qualified as non-detect ("U"). The result will be qualified as non-detect at the reported concentration if the reported concentration is >RL or as non-detect (U) at the RL if the reported concentration is <RL.

For aqueous blanks applied to soil/sediment samples, qualification is assigned based on comparison of the sample result to the equivalent concentration in the blank. The equivalent concentration is determined by assuming that all of the analyte present in the blank aliquot analyzed is present in the soil sample aliquot analyzed. The reviewer should note that the blank analyses may not involve the same weights, volumes, or dilution factors as the associated samples. These factors must be taken into consideration when applying the 5x or 10x criterion, such that a comparison of the total contamination is actually made.

A reason code of "RB" will be assigned to all results qualified on the basis of rinsate blank results. A bias code of indeterminate will be assigned.

3.1.9 Reporting Limits

The contracted laboratories are reporting positive results below their standard reporting limits (RLs) when the values are greater than the instrument detection limit (IDL) or method detection limit (MDL).

RLs or Practical Quantitation Limits (PQLs) are typically set at some factor above the IDL or MDL to ensure greater confidence in the accuracy of the associated quantitative value. Thus, at the RL (or PQL), a value typically set at 3-10 times the IDL or MDL, the degree of uncertainty would be more like +/- 25%. Thus, the PQL is the smallest concentration of the analyte that can be reported with a specific degree of confidence (i.e., the low concentration point of the calibration curve is less than or equal to the RL/PQL). When the RL/PQL is adjusted for sample weight, percent moisture, and dilution factor for individual samples, the result is a sample-specific quantitation limit or SQL.

To reflect the higher degree of uncertainty associated with values reported between the IDL/MDL and RL/PQL, these results are qualified as estimated ("J"). A qualifier code of SQL, denoting sample quantitation limit, is assigned to results qualified for this reason. A bias direction of indeterminate is assigned.

3.1.10 Other Items Identified in the Case Narrative

If an issue identified in the case narrative is not covered by the subsections above and is found to potentially adversely affect data quality, the data reviewer shall evaluate the problem based on SAP and/or method requirements, as applicable. If the SAP and/or analytical method does not specify requirements related to the criterion under evaluation, the data reviewer should utilize professional judgment to evaluate the effect of the reported item or condition on the associated analytical data. All uses of professional judgment shall be described in the report of the data validation process.

3.1.11 Completeness of the Data Package

The analytical data packages are evaluated for completeness of deliverables against the following criteria:

- Presence of tabulated results for all specified compounds identified and quantified and RLs for all analytes.
- Presence of results for all methods requested on the COC forms for each sample.
- Presence of a case narrative, COC forms, and the sample receiving forms.
- Presence of: QC summary forms for blank results; QC summary forms for MS results with calculated percent recoveries; QC summary forms for post-digestion spike recoveries (as required) with calculated percent recoveries; QC summary forms for laboratory duplicates and/or spike duplicate results and calculated RPDs; QC summary forms for serial dilution test with calculated %Ds; and QC summary forms for LCS sample results with calculated percent recoveries.
- When full data packages are requested, the package will also be reviewed for QC summary forms for initial and continuing calibration verification as well as supporting raw data for all of the aforementioned items and any pertinent review parameter discussed in Section 3.2.

Data package deliverables that do not meet the above criteria are documented, and the missing deliverables will be requested from the contracted laboratory. Any documents not obtainable from the laboratory are noted in the data review narrative.

3.2 REVIEW OF LABORATORY PERFORMANCE PARAMETERS

The review of laboratory performance parameters includes evaluating operations that are in the control of the laboratory, but are independent of the field samples being analyzed. Evaluation of these parameters provides an overall representation of the analytical system at the time of analysis. Data intended for stringent uses (e.g. litigation support, etc.) will also receive a review of laboratory performance parameters. If such a review is specified, laboratory performance parameters will be reviewed for at least one data package or 2% of the data (per method), whichever is greater. If review of any of the laboratory performance parameters indicates a systematic problem may exist, that review parameter will be evaluated for all data packages from that laboratory for that sampling event/episode.

Each of the subsections below describes in general how each laboratory performance parameter is evaluated. As noted in the introduction to Section 4, the hierarchy for criteria used to evaluate each parameter is as follows. A parameter is first evaluated against the requirements set forth in the SAP. If the SAP does address that parameter, the parameter is evaluated against the requirements stated in the analytical method. If the method does not specify acceptance criteria, results for the parameter are compared to acceptance ranges based on laboratory historical data.

While conducting the review described below, the data reviewer will evaluate whether the case narrative adequately summarizes all issues potentially affecting data quality (i.e., is the case narrative a reliable indicator of potential problems within the entire data package?). This assessment will be used to determine the need to evaluate specific laboratory performance parameters for the entire data set rather than just the predetermined portion of the data set (i.e., one data package or 2% (per method)).

3.2.1 Initial Calibration

The requirements set forth in the SAP and/or method, as applicable, will be used to evaluate whether:

- The initial calibration was performed at the required frequency using the proper number of standards at the proper concentrations,
- Whether the RL or CRQL is supported by the low point standard,
- Whether adequate response was obtained for each analyte for each standard,
- Whether the applicable linearity criteria were met, and
- Whether the initial calibration was verified properly.

If the initial calibration evaluation criteria for any analyte are not satisfied, then all results for that analyte associated with the initial calibration will be qualified as estimated ("J/UJ"). A reason code of "ICAL" or "ICV" will be used depending on whether the condition was due to the initial calibration or verification of the initial calibration. If the data reviewer can discern a probable magnitude and/or direction of bias to the associated sample results based on the information provided, then appropriate qualifier bias codes will be assigned.

3.2.2 Continuing Calibration Verification

The requirements set forth in the SAP and/or method, as applicable, will be used to evaluate whether:

- The continuing calibration verification was performed at the required frequency using the proper standard at the proper concentration,
- Whether adequate response was obtained for each analyte, and
- Whether the responses obtained indicate that the instrumentation is still operating within an acceptable range (drift).

If the continuing calibration evaluation criteria for any analyte are not satisfied, then all results for that analyte associated with the unsatisfactory continuing calibration (i.e. bracketed before and after) will be qualified as estimated ("J/UJ"). A reason code of "CCV" or "CCAL" will be used for inorganic and organic methods, respectively. If the data reviewer can discern a probable magnitude and/or direction of bias to the associated sample results based on the information provided, then appropriate qualifier bias codes will be assigned.

3.2.3 Laboratory Control Sample Analysis

Laboratory control samples (LCSs) are "clean" well-characterized samples used to monitor the laboratory's day-to-day performance of routine analytical methods. LCSs are prepared by spiking samples of a "clean" matrix with known amounts of target analytes and then processing the sample in the same fashion as all other samples. LCSs are used to monitor the accuracy and precision of the analytical process independent of matrix effects. The accuracy of the analytical process is evaluated using the calculated percent recoveries (%Rs) of the spiked analytes.

The reviewer will verify that all target analytes were spiked into the LCS sample. The LCS percent recoveries will then be compared to the acceptance limits in the SAP, method, or laboratory historical limits (if the laboratory acceptance limits are considered to be comparable to those specified in the methods), as applicable.

- If the LCS recovery for an analyte is greater than the upper acceptance limit, suggesting a potential high bias in reported results, all positive results for that analyte in all associated samples will be qualified as estimated ("J") whereas non-detect results will be considered acceptable for use without qualification because the high bias does not affect non-detect results.
- If the LCS recovery for an **organic** analyte is less than the lower acceptance limit but ≥10%, positive and non-detect results for that analyte in all associated samples will be qualified as estimated ("J" or "UJ").
- If the LCS recovery for an **organic** analyte is <10%, positive sample results will be qualified as estimated ("J") whereas non-detect results will be qualified as unusable ("R") for all associated sample results.

In the case of unacceptably low LCS recoveries, the reviewer will verify that the laboratory re-prepared and re-analyzed all associated samples, including the LCS and that acceptable results were obtained for the new LCS.

A reason code of "LCS" will be assigned to all results qualified as estimated or rejected on the basis of LCS recoveries.

3.2.5 Compound Identification

For 10% of the results reported in the data packages under going an evaluation of laboratory performance parameters, the reviewer will verify that results positively identified meet all identification acceptance criteria as specified in the SAP and/or analytical method. In addition, the reviewer will examine the data for false negative results.

For organics, this may encompass comparing retention times against retention time windows, evaluating the agreement between dual column confirmation results, comparing relative retention times (RRTs) for samples to RRTs for standards, and comparison of mass spectral data to reference spectra, depending on the analytical technique employed (note: this listing is not all inclusive).

3.2.6 Target Analyte Quantification

The reviewer will verify that reported sample concentrations can be recalculated from the raw data for 10% of the reported sample results in the data packages under going an evaluation of laboratory performance parameters. The reviewer will verify that reported results were calculated using the proper signal response for the sample, calibration factor or relative response factor, internal standard response, dilution factor, internal standard concentration or mass, percent solids, sample weights or volumes, final extract volume, etc. as applicable to the analytical method.

If errors are found in the reported sample results, the laboratory will be contacted and corrected results will be requested. The data review narrative will detail any such instances and the resultant resolution. The reviewer will collate the revised data into the data package and mark the all revised and all superseded data accordingly.

In some cases, multiple analyses for the same sample may be reported. The multiple analyses may be due to high target analyte concentrations that necessitate dilutions, interferences, or QC failures (e.g. low surrogate recoveries). When there is more than one set of data reported for a sample, the reviewer will need to select the best set of data to report based on all of the supporting QC information. This may involve selecting results from each of the multiple analyses. The data review narrative will detail the results selected for reporting and the supporting rationale. The data sheets will be marked to indicate which results were selected for reporting and which were not.

3.2.9 Verification

The reviewer will verify that information reported on the summary forms was calculated properly and that the results are traceable back to the raw data. In addition, the reviewer may also verify that all spike solutions and standards were used within their recommended shelf lives.

If errors are found in the reported sample results, the laboratory will be contacted and corrected results will be requested. The data review narrative will detail any such instances and the resultant resolution. The reviewer will collate the revised data into the data package and mark all revised and all superseded data accordingly.

4.0 DOCUMENTATION

This section describes the documentation that will be generated as part of the data review procedure. All data validation results will be documented in a narrative report. The section below describes the contents of the resultant data validation reports.

4.1 DATA REVIEW NARRATIVE REPORTS

All data review activities will be detailed in a data validation narrative report. The report will be produced for each data package reviewed or, if a collective assessment is being performed, for a sample delivery group or sampling event, whichever is specified. At a minimum, the report will include an introduction (Section 1), a summary of the data review process (Section 2), data review narratives for the review of laboratory performance parameters (Section 3), data review narratives for the review of sample-specific parameters conducted on each package (Section 4), and an overall assessment of the data (Section 5). The overall assessment will state any limitations to the usability of the data as well as address the quantitative and qualitative data quality indicators of sensitivity, accuracy, precision, completeness, representativeness, and comparability. All data review reports will be peer reviewed by a qualified person to assure compliance with the procedures described in this SOP.

Table 1
DATA VALIDATION QUALIFIER DEFINITIONS

Qualifier	Definitions [1]
U	The analyte was analyzed for, but was not detected.
J	The analyte was positively identified; the associated numeric value is the approximate concentration of the analyte in the sample (i.e., estimated value).
UJ	The analyte was not detected. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification."
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associate numerical value represents its approximate concentration.
R	The data are unusable and have been rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte can not be verified.

[1] USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, 2008.

Table 2
DATA VALIDATION QUALIFIER REASON AND BIAS DIRECTION CODES

Qualifier Code	Data Quality Condition Resulting in Assigned Qualification
General Use	
HT	Holding time requirement was not met
P	Preservation requirement(s) not met
MB	Method blank or preparation blank contamination
LCS	Laboratory control sample evaluation criteria not met
MS	Matrix spike and/or matrix spike duplicate accuracy evaluation criteria not met
D	Duplicate or spike duplicate precision evaluation criteria not met
RB	Rinsate blank contamination
FD	Field duplicate evaluation criteria not met
ID	Target compound identification criteria not met
IS	Internal standard evaluation criteria not met
CO	Suspected carry-over
SQL	Reported sample concentration is between the method detection limit and the sample quantitation limit.
RL	Reporting limit exceeds decision criterion (for non-detects)
LR	Over linear range without re-analysis
Organic Methods	
TUNE	Instrument performance (tuning) criteria not met
ICAL	Initial calibration evaluation criteria not met
CCAL	Continuing calibration evaluation criteria not met
SUR	Surrogate recovery outside acceptance range
Bias Codes	**Bias Direction**
H	Bias in sample result likely to be high
L	Bias in sample result likely to be low
I	Bias in sample result is indeterminate